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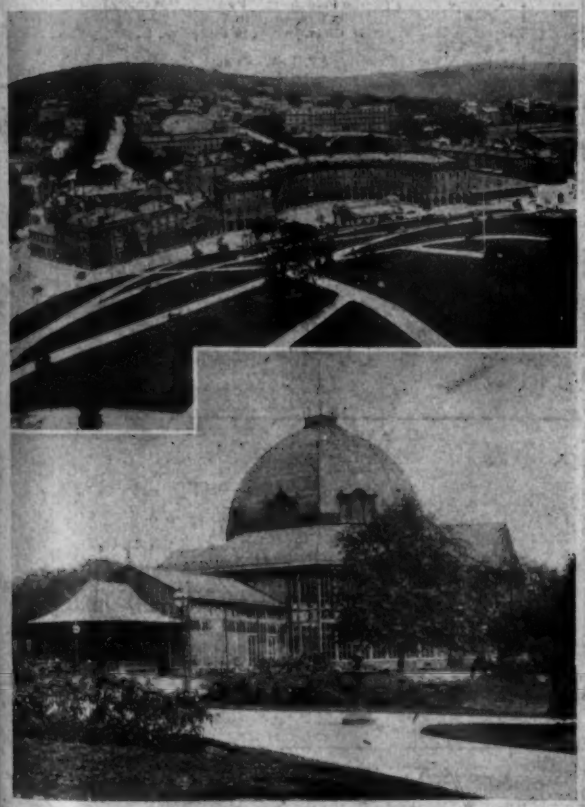

BUXTON:
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CONTENTS

OF THE

APRIL NUMBER.

EDUCATION IN PARLIAMENT—FEBRUARY-MARCH 487
BY MANY HANDS 488
N.U.T. NOTES 490
NOTES FROM THE NORTH 492
WITH OUR CHILDREN 493
THE CONFERENCE TOWN 494
A TECHNICAL SCHOOL FOR WOMEN 498
SUPPLEMENTARY COURSES IN DAY SCHOOLS 499
NATURE STUDY FOR THE MONTH. By J. O. Borley, M.A. .. 501
NATURE-KNOWLEDGE. By James Knight, M.A., B.Sc. 503
HISTORY DAY BY DAY 505
OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK 507
PHYSICAL TRAINING. A Progressive Course for Elementary Schools. By H. Ripon-Seymour, A.C. 508
THE INSPECTOR'S NOTEBOOK 510
A SCHOOL NEWSPAPER 511
CIRCULAR FROM BOARD OF EDUCATION 511
OUR MODEL INFANTS' SCHOOLS 512
SOME USEFUL BOOKS 516
OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE. By A. T. Flux 517
LOGIC FOR L.L.A. AND LONDON MATRICULATION. By T. E. Margerison, M.A. 523
OUR CERTIFICATE COURSE FOR 1903. By G. Collar, B.Sc. 524
OUR FRENCH PRIZE COMPETITION 527
PHYSIOGRAPHY 528
CHEMISTRY 529
ELECTRICITY AND MAGNETISM 530
THEORETICAL MECHANICS 531
OUR QUERY COLUMN 533
THE EDITOR'S TABLE 537

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THE PRACTICAL TEACHER

A MONTHLY MAGAZINE AND REVIEW

FOR THE SCHOOL-ROOM AND THE STUDY

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EDUCATION IN PARLIAMENT—FEBRUARY-MARCH.

THE King's Speech announced an Education Bill, of course. Education Bills are now a standing dish in the sessional bills of fare; Education Bills seem likely to stretch along the path of time up to the very crack of doom. Whatever else may snore and slumber at St. Stephen's, the question of Education will not.

Former members of Parliament are fond of "revisiting the glimpses of the moon;" they "linger round the very spot," and hang about the lobbies, peering in through the guarded portal like Moore's Peri at the gates of Paradise. Should one of them develop the tendency of Rip Van Winkle, and descend upon Parliament from the Catskills after a century of suspended animation, he would be quite sure of finding, in the year 2003 or thereabout, the British House of Commons discussing an Education Bill. *C'est fatal*, as the French Minister of Education said.

There are so many arrears to make up—that is the reason for this annual attention to questions of Education. It is not because members of Parliament, as a rule, are fond of the topic. True it is that any member and every member thinks he can speak with wisdom on an Education Bill. Members who are silent on every subject else get up with astonishing frequency on Education, no matter how little they know about it. Education is the cockshy of every Parliamentary sportsman; and this is rather irritating to the men in the House of Commons who *do* know, and are qualified to discuss an Education Bill.

But the real reason for this plethora of Education Bills is not to provide a subject for shy and ill-informed speakers; it is because there are arrears to be overtaken, and there must be arrears remaining for years to come. English legislation is patchwork and piecemeal; each Act omits something, leaves something over for another session's debates. The Education Act of 1902 left a good deal over, and hence the Education Bill of 1903.

It is a London Education Bill that this session is to see. Doubtless the Government, and even the House, would be glad if the London Education Bill could stand over till 1904. *Toujours perdrix!* one can have too much of even a good thing. But the London Education Bill can no longer wait. Sir John Gorst and his friends, three years and more ago, with their Clause VII., and their Cockerton judgments unredressed, and all the manœuvres they perpetrated or fostered against the really popular and efficient schools of the country, made the Act of 1902 inevitable, and a London Education Bill in 1903 a certain corollary. The Act of 1902 set straight all the tangle and ravel which Sir John Gorst and his friends had wrought in the fabric of public Education, so far as the provinces of England and Wales are concerned; but Cockertonism, and starved denominationalism, are still rife in the metropolis. Dr. Macnamara's Act prolonged the life of the School Board higher-grade and evening-school work in London, despite the Cockerton law; but only for a twelvemonth. Can London wait? Can London wait longer than 1903? "The answer," as Ministers say at question time, "is in the negative."

Besides, there is the question of Scottish Education coming on for consideration. "One and the same authority" is now a principle established for England and Wales, and why not for Scotland, a good many Scottish members of Parliament want to know. The Equivalent Grant Bill, by which a sum, in respect of the sums voted for England under the Education Act of 1902, will become payable to Scotland, will be a peg and opportunity for discussing if Scotland stands where she did in matters educational. Already Dr. Douglas, M.P., has issued a pamphlet-book in favour of reconstruction of School Board areas ayont the Tweed.

The Government, anxious for time, like all Governments, may fob off Scottish Education a year, but the sibylline book of London Education must be opened this year. A fine confused set of cross-readings, glosses,

and *variorum* interpretations is the result of its opening already. There is only one interpretation of the problem which is clear, cogent, and undeniable—that is the suggestion made by the teachers. The teachers who adumbrated the plan adopted for the provinces in 1902 are to the fore with the only rational and feasible plan for the metropolis in 1903. A directly-elected Board, specially constituted for educational purposes, and for educational purposes alone, is what the National Union of Teachers and the Metropolitan Board Teachers' Association prescribe. But many other prescriptions are tabled for the use of the London patient. The London County Council; a Committee of the London County Council; a statutory Committee of the London County Council and the London Borough Councils; a nominated Board representing the London County Council, the Borough Councils, the City Guilds, and what not—these are the principal proposals heard. But all these are proposed, not because they are best for Education, but because they suit some non-educational predilection or flatter some non-educational prejudice. Some M.P.'s hate the London County Council and admire the Borough Councils; some believe that the perfecto-municipal idea, by which all and each of the municipal functions are to rest in the hands of the one municipal authority, ought to rule in London as elsewhere. The teachers' proposal is educationally the best, and administratively the most practical; but it has the drawback to popularity in the House of Commons, that it seeks to establish what sneerers call "a glorified London School Board."

Few members of Parliament admire the School Board for London. With Mr. Lyulph Stanley for engine-driver and Mr. Graham Wallas for stoker, it has been an engine driven without wisdom, tact, or avoidance of danger and offence. Hardly anybody in Parliament will say a word for its continuance—remarkable, indeed, with what pusillanimous and silent inactivity it awaits its death. The same was true of the provincial School Boards, no doubt—they stood like aged beasts in the slaughter-house, drooping their heads, and waiting the pole-axe. The inevitability of the Act of 1902 may be judged by that; the inevitability of the death of the London School Board seems almost as sure. If it has any chance of being revived, in another and larger body, it owes that chance, not to its leaders or members, but to the teachers in London.

The Government have vacillated for weeks past, it is said, from one decision to another as to what the Education authority is to be. The other parts of an Education Bill for London may be short and simple, consisting mainly of a clause which applies the Act of 1902, *mutatis mutandis*, to the London area, except in respect of the local authority. It is the constitution of the local authority which is giving the Government so much trouble.

First of all there is the London County Council to be dealt with; and the Council's claims to be the authority are, strange to say, backed by the bishops and clergy of the Established Church. Then there are the Metropolitan Borough Councils, which aspire—some of them, at least—to be the local authority themselves. But the Church, and a section of the London Unionist M.P.'s, will have none of the Borough Councils as an educational authority. Now, the Government relies on the metropolitan M.P.'s for guidance and support in this matter, and if some M.P.'s will have none of the London County Council, and some will have none of the Borough Councils, what is a poor distracted Government to do?

The great meeting of teachers in the Queen's Hall happened very *à propos*, at an hour when the Government was vacillating on this question again. It had the effect of giving the *ad hoc* solution of the difficulty a new lease of life. Many deputations of teachers have interviewed the London M.P.'s in favour of the *ad hoc* plan, and much ingenuity in keeping it alive has been expended. The objection to it is not cogent or rational; it is one of prejudice: the London School Board has not made itself liked, and an *ad hoc* authority is thought to mean another London School Board. Mr. Diggle and Mr. Stanley have many sins against Education to answer for, and this is one of them.

However, at the moment of going to press, it is quite impossible to say, and almost to guess, with any degree of accuracy, what form the Education authority for London will take in the forthcoming Bill. But it is by no means certain that the Bill in its original form will remain unchanged. Keen wits, unflagging industry, and great Parliamentary influence will play upon the Bill and modify it. In this, again, it is fortunate, and doubly fortunate, that Education has her own skilled, experienced, and respected spokesmen in the House.

BY MANY HANDS.

"Quot homines, tot sententiæ."

Philosophy at Sixpence.

WHEN a book reaches the form of the sixpenny edition, it is a pretty sure sign that it has attained to the zenith of popularity. For years past we have been accustomed to the piles of the sixpenny editions of popular novels and literature of the lighter and entertaining character. People must read, if only for recreation, and poetry and romance are the kind of literature to which the mass of jaded workers fly for entertainment and mental recreation. But when we discover among these slim volumes others decked out in a similar garb, but dealing with occult science and abstruse philosophy, jostling, as it were, among the crowd of light-hearted fiction, and courting the smile of popular recognition, we pause awhile to ponder and pleasantly wonder. Publishers would not print such books unless there were a demand for them. They are appearing in quite a rapid succession, a fact which goes to show that there is a reading public that really thinks. But a few days ago we saw an intelligent artisan in the train perusing a sixpenny Darwin. Now we have Herbert Spencer's *Education* in the popular form—this, too, while the great philosopher is yet alive. Surely these are hopeful signs. The schoolmasters have not been toiling in vain.

Herbert Spencer in a Bath-chair.

WE are indebted to T. P. O'Connor for the really vivid sketch which he has given us of Herbert Spencer in the flesh. Here it is: "It is not unusual in a health-resort like Brighton to see men in bath-chairs; but it is not often that you see them all by themselves, with the bath-chairman standing apart and silent, and

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the patient, all alone, unspeaking, unspoken to, and gazing out apparently in a deep dream which it would be sacrilege to interrupt. As you pass you cannot help being struck, too, by the suggestion of extraordinary depths in those eyes that are thus directed out to sea. Though you cannot help feeling that the reveries are deep, you at the same time have a sense that they are not futile, vain, fruitless; they belong not to the region of hopes, or fears, or regrets; they are not the waking dreams of the poet. The thin, well-shaped nose; the whiskers, cut a little after the fashion of the professional man of English birth; above all, the mouth, with a long upper lip, and yet beautifully chiselled, and with a certain severity that is almost grim—all this precludes the idea of the man whose life has been interrupted or haunted by mere dreams and emotions. This is evidently a man who has led a keenly active, intellectual life—a life given to fruitful thought, and not to vacuous dreams." It is good, sometimes, to see one's heroes in the flesh, and many a wondering student will read again and again T. P.'s vivid description of this great man—"the greatest philosopher that this generation of Englishmen has produced."

IN the *Revue Pédagogique* a series of articles on "Education by Manual Training" has been begun by M. J. Baudrillard. He says that the words "ambidexter" and "ambidexterity" are being bandied about in France in newspapers and educational reviews. They have even had the honour of being pronounced from the rostrum by municipal councillors of the city of Paris. It is therefore high time, he thinks, that the real significance of these terms should be examined and made apparent—which task he has set himself in these articles.

Baudrillard on Tadd.

Quite naturally he has turned to the book and practices of Mr. J. Liberty Tadd (whom readers of the *Practical Teacher* will remember), since it is in connection with his work that the terms have been most frequently used. Like many of those who have heard and studied the Philadelphian, M. Baudrillard regrets that ambidexterity should have become affixed like a label to the ideas which our American colleague has so much at heart. He offers one spice of consolation—namely, that, misleading as the terms are, they have served as convenient advertisements for the wider circle of ideas contained in the general manual-training system of Mr. Tadd. Our French colleague is much in earnest, and mentions quite a formidable number of authorities he has consulted as an aid to his analysis of Mr. Tadd's method. When finished, we will give a *résumé* of them, since they may throw a new light on a subject of more than ordinary interest.

SOME interesting studies of adolescence have appeared from time to time on the other side of the Atlantic; another one has recently commenced in the *Journal of Pedagogy*. Our American cousins are in the right to study this fateful period of human existence, for on the correct knowledge of its characteristics depends the successful handling of the adolescent. In this connection Rousseau's words are very striking: "We are born twice—once to exist, the second time to live. The first time, with regard to the species; the second, with regard to sex: and to each of these two sorts of being there should correspond a suitable education. It is exactly at the opening of this second sort of life—that is, from thirteen to fifteen years of age—that almost all French youths leave the primary school. It is at the very moment when the human being begins to live, and must henceforward learn how to live, that oftenest his instruction ceases." There is profound truth in that; and it forms an unexpected plea for the continuance of the school age, or for the provision of such facilities that the first school period passes naturally into a second one, and thus continues the education of the budding youth through the most dangerous and impressionable period which he or she experiences.

Adolescence.

THIS is no fiction. The less densely-populated districts of the United States suffered much from the inefficiency of their schools. When each township had its own school, it was often poorly equipped, badly staffed, and worse attended. So the plan of concentration was adopted. One excellent school was founded for territories measuring from 60 to 100 square miles, to which pupils were brought, at the expense of the state, from the outlying districts. So that the school omnibus, specially constructed and fitted up, is no fiction but a fact. This is municipal trading on a very extensive scale—speaking territorially—and, as is often the case, it pays. The states which have adopted this concentrated form of schooling save, so it is declared, sums upwards of one hundred pounds per month on the expenses incurred under the old system. At a moment when the New Education Act is making all sorts of ideas regarding the education of rural England practically possible, it is as well to point out the successful working of this plan across the water. We owe America many things besides "canned" goods and the gramophone; perhaps here is yet another idea which we may borrow from the same prolific source.

The School Omnibus—

WITH intense gravity all the advantages of this educational concentration camp are set forth, and we feel sure that some of them will rouse an echo in the hearts of weary teachers in rural England. Thus:—

1. Equipment is better and fuller.
2. Bad weather is no cause of absence. (The omnibus is, we suppose, a closed vehicle, or at least a closable one.)
3. As the children are called for at their homes, *they can't play truant.*
4. Average attendance goes up by 12½ per cent.
5. No child has anything to fear from tramps, vagabonds, or evil-minded persons, so that in the most out-of-the-way spots the hearts of the parents are quite tranquil.
6. The teacher has a wider choice of residence and social relations; he escapes from the narrowing influences of village life.

They make quite a respectable list of gains these tabulated improvements brought about by the school omnibus, and they really indicate that the little, badly-attended schools of the sparsely populated districts of England might profitably disappear in favour of one fine, well-filled building, served by relays of buses.

And its Advantages.

THIS is not a war cry. It is the title of an article in the *Journal des Instituteurs* which has nothing to do with yellow or black men, or any other political hobgoblin, but deals with a rumour that has been current in France. Since 1854 the nominations of the primary teachers in France have been in the hands of the prefects. The

The Primary Peril.

rumour ran that in future these nominations would lie in the power of the rectors of the academies—that is, regional university colleges. But the rumour proved false; hence the sinister meaning of the title of the article. There is much justice in the arguments urged. The nomination by *MM. les Préfets* is a device of the times of the Empire. The prefect is a political functionary, a movable one, who has to please the elected members of his department; he knows nothing of professional qualifications for the post of teacher: whereas a rector is comparatively independent; he owes his position to his personal and professional abilities; he understands what goes to make a good teacher, and can recognise one; and —there is so much less of him, only one to four or five departments. And so the disappointed article-writer wails over the exploded rumour, and calls the prefect—the real primary peril. The conclusion is admirable. He quotes the words of a delegate of the primary teachers, at a banquet to the Minister of Education: "We adjure you in the name of the highest interests of the country, and for the salvation of the Republic, to set us free at once from the politicians." That last phrase is superb. When *will* education be free from the politicians? We should much like to know that ourselves.

N.U.T. NOTES.

IN March's opening days, a representative deputation from the National Union of Teachers waited upon the Marquess of Londonderry, K.G., President of the Board of Education, to submit to him certain views on the questions of Physical Training, and Inspection *versus* Examination. An engagement at Bolton unfortunately prevented my own attendance at Whitehall; but from all one can learn, the proceedings were of so cordial and friendly a character as to bode well for the future of education in this country. By previous arrangement, Mr. Jackman introduced the Drill question in a speech of great ability and studied moderation. Miss Selvage and Mr. R. N. Lewis stated the position from the rural teachers' point of view; whilst Miss Broome and Mr. Blacker gave some account of the difficulty, if not the absolute impossibility, of carrying out the "Model Course" in many schools. Two or three times during his reply the Marquess of Londonderry assured the deputation that he was "*not of the red-tape stamp*" himself, and from this confession one hopes much. He seemed sincerely anxious to smooth away all difficulties, being obviously impressed by the manner in which these had been set forth. One sentence in his speech has puzzled me more than a little: "Colonel Fox has told me that in some districts he has been surprised and delighted at the keenness shown by teachers in travelling great distances at great personal inconvenience to take part in these classes." All I can say is that Colonel Fox's experience does not, by any means, "square" with that of the countless teachers I myself have met, from one end of the country to the other. The Drill question out of the way, Mr. Sharples, chairman of the Education Committee of the Executive, dealt with the subject of Inspection *versus* Examination, and was followed (at the President of the Board's request) by a certificated class-master, Mr. W. A. Nicholls. Both gentlemen, from lengthy and varied personal experience, were able to convince the marquess that a general reversion to the days of individual examination would be disastrous to the children's best interests. Lord Londonderry went far to meet the wishes of the deputation when he at once agreed that examination should only be undertaken by H.M. Inspectors after due notice—"say, in six months' time"—had been given. The appearance of the new Code will be awaited with unusual interest, in order to see the form the new instructions take.

"Drill" and "Inspection."

WHATEVER doubts may have existed as to the attitude of London teachers regarding the composition of the new education authority for the metropolis were dispelled by the magnificent meeting at Queen's Hall on the evening of 3rd March. Half an hour before the time fixed for the commencement of the proceedings practically every seat was occupied, and "still they came," until the attendance approximated five thousand men and women keenly interested in the evening's programme. There was practically but one resolution—"That all public education in London, primary and higher, should be placed under the control of a directly-elected Board of Education for London, devoting itself exclusively to purposes of educational administration"—and this was in the capable hands of Dr. Macnamara, M.P. Needless to say, the member for Camberwell had a great reception, and he unrolled his ribbons of facts in the delightful fashion so peculiarly his own. Mr. Gautrey, the experienced and trusty secretary of the M.B.T.A., seconded, in a style the very antithesis of "Doctor Mac's"; and then—in order to evince that *education* and not *politics* was the object of the demonstration—Mr. Ernest Gray, M.P., supported. Not a hand was raised against the resolution, and the chairman's declaration, "Carried unanimously," was the signal for sustained applause. The motion, "That copies of the foregoing resolution be forwarded to the Prime Minister, the Leader of the Opposition in the House of Commons, his Grace the Duke of Devonshire, Earl Spencer, the Earl of Rosebery, the Marquess of Londonderry, Sir William Anson, M.P., and the Secretary of the Board of Education," served as a peg for three short, pithy speeches by the Rev. A. W. Jephson, Mr. Jackman, and Mr. Yoxall, M.P., and each gentleman spoke admirably. To the officers of the London associations and the M.B.T.A., to the 150 gentlemen who acted as stewards and marshals under the experienced leadership of Mr. T. F. Bowers, B.A., and to Mr. Jackman, who worked night and day for the success of the gathering, the Union's grateful thanks are due. Were I to attain to the ripe age of even Methuselah, I could not hope to preside over an assembly more hearty, more orderly, or more deeply interested than the Queen's Hall *ad hoc* meeting.

At Queen's Hall.

AT its last meeting, the B. and O. Council agreed to certain important recommendations of its Finance and General Purposes Committee, the effect of which will be to increase the yearly expenditure by some £2,000. I give below some of the more important of these:—

"B. and O." Council.

1. That, as a general principle, additional aid shall be given to increase the number of beneficiaries rather than the amount of the individual benefits.

2. That the Council recommend the Annual Meeting to substitute 3s. 6d. for 2s. 6d. in the last line of Rule 58. (Rule 58 now reads as follows: "The Central Council may, if they see fit, make special grants or gratuities to the orphans and necessitous children of

teachers. These grants may be supplementary to allowances already secured by election, but shall in no case exceed a sum of 2s. 6d. per week for one year.")

3. (*a*) That the number of annuities be increased. (*b*) That the Council recommend the Annual Meeting to approve a supplementary election for annuities, to take place at as early a date as possible in 1903; that not more than twenty additional annuitants be elected under this scheme; and that, in order to save expense, the election be held by the Council.

4. (*a*) That the number of home allowances be increased. (*b*) That the Council recommend the Annual Meeting to approve a supplementary election for home allowances, to take place at as early a date as possible in 1903; that not more than twenty home allowances be granted under this scheme; and that, in order to save expense, the election be held by the Council. (*c*) That all home allowances to children over twelve years of age be increased from 5s. per week to 7s. 6d. per week.

The following interesting summary of contributions from electoral districts was submitted:—

District.	Title of District.	Averages.		
		1900.	1901.	1902.
		s. d.	s. d.	s. d.
1	N. England	3 8	4 3	13 5
2	Lancashire	4 10	5 3	6 1
3	Yorkshire	14 6	4 4	9 1
4	N. Midland	4 3	4 5	12 6
5	S. Midland	5 0	5 4	5 7
6	E. Anglia	3 9	8 1	3 10
7	S. England	5 7	4 8	4 8
8	W. England	4 3	6 5	6 3
9	Wales	2 6	3 2	5 1
10	N. London	3 6	3 7	3 8
11	E. London	4 4	4 8	5 2
12	S. London	4 5	4 7	5 0

POSSIBLY the keenest fight ever known for the honour of entertaining Conference occurred in the closing days of March last year, and the wonderful fashion in which Buxton finally won is still fresh in my memory. For twelve months its plucky forty members have been hard at work over the innumerable details engendered by a visit of Conference, and their preparations are now all but complete. In little over a week the "early birds" will begin to wend their way towards Derbyshire's famous health-resort, and receptions—more or less informal—will be held on both the day before and after Good Friday. Last year quite an appreciable number of delegates and friends journeyed towards Bristol at the earliest possible moment, and doubtless this year the agreeable experience will be repeated.

Nearing Buxton.

EASTER 1902 witnessed a notable innovation in the arrangements for the opening day; and so successful was it deemed, that this year's Easter Monday's proceedings will be on similar lines to those of last year. At 11 a.m. the chairman of the Buxton Urban Council and other representative townsmen will attend and welcome the Conference; and after they have been duly thanked, the retiring President will introduce Mr. Harry Coward, Knowle Board School, Bristol, and install him as President for the ensuing year. On the motion of a dear and valued colleague, Mr. George Sharples, Conference will be asked to recognise the services of the retiring President, who, before replying, will be decorated with the President's badge by Mrs. Coward. The deputation from Scottish, Irish, and foreign professional organisations will next be received, and an ovation naturally awaits the genial Van Dam, who annually represents—himself!

The Opening Day.

The afternoon's proceedings are timed to commence at 2.30, and the President's address is naturally the *pièce de resistance*. A comprehensive and statesmanlike pronouncement on the nation's educational affairs will assuredly be forthcoming from Mr. Coward, and my sincere hope is that he will have as large, attentive, and sympathetic an audience as I was honoured with, twelve months ago. The result of the election for Vice-President furnishes an appropriate "tit-bit" with which to ring down the curtain for the day.

THE public sessions are, as usual, fixed for the mornings of Tuesday and Wednesday in Easter week, and the subjects for discussion, chosen by a plebiscite of the local associations, are of absorbing interest. On Tuesday, Examination *versus* Inspection, Salaries of Teachers, Discipline in Schools, and Appointment of Inspectors have pride of place. A paper on the first-named subject will lead up, in fitting fashion, to a motion thereon; and Conference will be delighted to hear what the veteran, Mr. Robert Wild, B.A.—twice President of the Union—has to say on the present position. "Spatchcocked" into the proceedings will be the presentation of a testimonial to Sir George Kekewich, K.C.B., whose services to education and his country are thoroughly appreciated by the teachers in the primary schools.

Public Sessions.

At the fourth public session attention will be centred on the Register of Teachers, Appointment and Dismissal of Teachers, Superannuation of Teachers, and Staffing of Schools; although, of course, it is quite possible that "urgency" may be moved for any new topic (such as the London Education Bill), and then the arranged agenda may have to go by the board. At twelve noon, on Wednesday, votes of thanks will be moved from the chair to all those who have toiled and laboured for the success of the Conference.

THE purely domestic business of the Union will be taken on Tuesday and Wednesday afternoons, and I am hopeful that they will see Conference "clothed and in its right mind." However proud one is of the Union, it is difficult to become enthusiastic over the annual exhibition—I can use no milder term—which the consideration of the financial statement affords. Surely it is not too much to hope that the time for innuendo and unworthy insinuations has gone for ever! Confidential reports and log-book entries, organ of the Union, and election of the Executive may possibly all be discussed, but much depends on what transpires on Tuesday afternoon.

Private Sessions.

IN addition to the sessions of Conference, there is a variety of functions, entertainments, meetings, and excursions sufficient to keep the youngest and most energetic delegate thoroughly employed. On Monday evening, that particularly useful body, the Teachers' Provident Society, will hold its annual meeting; whilst the class teachers will foregather, as of old. The Temperance breakfast is set down for Tuesday morning at 8 a.m., the Conference dinner for Tuesday at 7 p.m., the Ladies'

The "Side Shows."

At Home for Wednesday at 7 p.m., the Conference Ball for Thursday at 8.30 p.m. Thursday is practically given up to the work of the Charities; for the annual meeting of the B. and O. Fund takes place at 9.30 a.m., and in the afternoon the Reception of Purses and Award of Trophies will "fill the bill." Given anything like spring weather, I anticipate a "record" gathering at Buxton during the second week in April. A. C.

NOTES FROM THE NORTH.

PERHAPS one of the most valuable, and certainly one of the most interesting and persuasive, contributions to the discussion on the proposed Scottish Education Bill is the book on "Scottish Education Reform" just issued by Dr. C. M. Douglas, M.P., and Dr. Henry Jones. After dealing with the defects of the present arrangements, and the great need there is for reform in education in Scotland, the writers discuss the various proposals that have been made for securing a satisfactory remedy. They lay down certain fundamental conditions which must be attained before a solution of the problem can be reached. These conditions, briefly stated, are that "the institutions for popular instruction must be so arranged as to provide for continuity of educational endeavour; and the education that is supplied in these institutions must be capable of easy adaptation to the needs of the Scottish people." To this end "the successive stages of school education must therefore be co-ordinated under one administration; and secondly, the supreme authority must be brought into such relation with the local bodies as shall secure that Scottish education is controlled by the Scottish people." These conditions lead them to consider the proposals already before the country. They do not favour the idea of combined School Boards, nor yet are they favourable to the authority for education being the County Councils. No doubt there are certain advantages which would follow the adoption of either of those schemes, but the objections to be urged against them are so great as to force the writers to discard these proposals in favour of what they call "District School Boards."

Scottish Education Reform.

THE adoption of the County Districts as areas and District School Boards as educational authorities, it is maintained, would obviate the objections and combine the advantages of the other two plans. The County Districts here referred to are those determined by the Local Management Act of 1889. They propose, therefore, an *ad hoc* authority, elected to administer public education—elementary, secondary, and technical. For its constitution they recommend the areas of the District Committees and the constituencies of the County Council. Towns with a population exceeding 50,000 are to have School Boards of their own; all other towns are to be included in the districts. Unfortunately, to my mind, they have not dealt with the question of rating—the fatal point in the last Bill introduced by Lord Balfour of Burleigh. Are the districts to be given the power of rating? Will there be a different school rate for each district of a county? The arguments brought forward for the County District are equally applicable, and in some respects more cogent for the County Area. I feel certain, however, that teachers would welcome either the County District or the County Area. What is desired is that teachers shall have reasonable security of tenure and ample opportunities of promotion. These would be secured by either of these proposals, and, as this is so, teachers will be content to have either the one or the other. The "suitably large areas" desiderated by the teaching profession as a whole are either of these. I would strongly recommend teachers to read this well-reasoned and beautifully written book. It is impossible in these notes to go more fully into the question as discussed by these writers, who are on many points well qualified to form public opinion on education. Mr. Haldane, M.P., contributes the preface.

District School Boards.

THE subject of a Scottish Council of Education situated in Edinburgh has been receiving considerable attention during the present discussion. While every educationist and teacher is willing to give the Scotch Education Department full and hearty recognition of the admirable way in which education has been controlled during the last few years, yet there is a feeling growing up, and increasing as the months go on, that it is somewhat autocratic in its government. At present local initiative is being stamped out, and even the largest Boards in Scotland are not free agents in the matter of education. Circular after circular emanates from "My Lords," and teachers and Boards are compelled to swallow these, whether they approve of them or not. There are many dangers to be avoided in the transference of the Scottish Council of Education from Whitehall to Edinburgh, but these dangers are in many quarters being over-estimated. There can be little doubt that in the House of Commons Scottish education is not receiving the attention it merits, and that is in large measure due to the fact that it is not in direct touch with the needs and aspirations of the country.

Scottish Council of Education.

THE time for nomination of candidates for the "blue ribbon" of the teaching profession of Scotland has now almost expired, and it would appear that only two candidates are to be before the Institute. The north of Scotland is making a bold bid for the honour. Mr. T. Wallace, F.G.S. (Ed.), F.S.A. (Scot.), is the nominee of the north-west province, and support is asked of the various branches on his behalf. Mr. Wallace has been long in the front rank of teachers. His scholarship and ability give him a good claim to recognition at the hands of his fellow-teachers. He has taken a deep interest in the Institute, and at one time was a vice-president. He is at present a member of the General Committee of Management. As a scientist, Mr. Wallace has done excellent work. He was one of the founders of the Inverness Scientific Society and Field Club. He originated the Northern Association of Scientific Societies, and is at present senior vice-president of the Edinburgh Geological Society. In July 1895 the *Practical Teacher* gave a full account of his work under the title of "Well-known Teachers at Work." Mr. Wallace is at present rector of Inverness High School. There can be little doubt that, if elected, Mr. Wallace will be found a fitting successor to the many illustrious teachers and educationists who have already occupied the presidential chair. Mr. J. M'Kenzie, head-master of Holburn Street School, Aberdeen, the second candidate for the honour, is also well known to the great body of teachers in Scotland. His interest in the In-

The Presidentship of the Institute.

stitute has extended over a long period. There is hardly a committee of the Institute on which he has not served.

MR. T. WALLACE.

As convener of the *Educational News* Committee, he took a great share in the buying up of the shares of that paper on behalf of the Institute, so that now the Institute is the "predominant partner" in this organ. Mr. M'Kenzie is highly respected by his professional brethren in Aberdeen. He represented the Institute at the York Conference of the N.U.T. As a hard worker in the cause of education, as a loyal servant of the Institute, Mr. M'Kenzie's claims cannot be lightly passed over. Whoever loses in the contest will live, I hope, to fight another day.

THE Institute is making great efforts at the present time to increase its membership. It is a very regrettable fact that it does not reckon among its members more than fifty per cent. of the teaching profession of Scotland. This is not as it should be, and consequently I am glad to learn that one of the committees of the Institute has earnestly taken up the subject of increased membership. It is to be feared that the greatest number of defaulters are among the lady teachers of Scotland, and it is a matter of great importance that the Ladies' Committee of the Institute is doing so much valuable work on behalf of their fellow-teachers. The ladies of Scotland and England, no doubt, will learn with great satisfaction that the Institute has resolved to send as one of their delegates to Buxton Conference a lady teacher, Miss Fish of Glasgow. This, I believe, is the first time the Institute has sent a lady, and the experiment will be watched with much interest. R. G.

E. I. S. Doings.

WITH OUR CHILDREN.

THE organ of the British Child-Study Association, which rejoices ("rejoices" is not the proper word, but we have seen the phrase somewhere, and may as well use it)—which rejoices in the name of the *Paidologist*, has now commenced its fifth volume, under the management of an editorial committee, members of the London Branch. The number for February does them much credit in the value of the articles which it contains. More than one of these has some permanent worth for the student of childhood. Dr. Langdon-Down, a well-known specialist in the matter, deals with the subject of perennial interest to teachers—Nervous or Neurotic Children. One feels somewhat relieved to observe that he assigns a very high place to treatment and education, and does not insist so much upon heredity, which is to the teacher equivalent to pure fatalism, leaving no room for efforts to ameliorate the state of the individual.

The "Paidologist."

DR. LANGDON-DOWN'S account of the varieties of abnormality which are shown by "exceptional" children is worth quoting: "We must not suppose, when we speak of a class such as this of neurotic children, that its constituents are entirely and distinctly separate from the mass of children. They are rather to be compared to the few shots on a target which have struck it rather farther from the centre than the majority, which approximate more or less closely to a centre which we may compare to our ideal type. The stray shots do not fall all on one side.....some are high, some fall short, others are to right or left of the main group, and some are so placed that it is hard to say whether they belong to the centre group or to the erratic margin. So we find some children err by defect, others by excess; some are precocious, and fly too high or follow an erratic course; some start with an original twist, which makes them go astray; others encounter obstacles or unfavourable conditions which deflect them in their progress; some have a momentum insufficient to overcome the adverse forces that all have to meet, and these individuals may be further apart from each other than they are from the central type." Of course analogies and metaphors are dangerous to the unthinking, whether in science or in politics, but we venture to say that this suggestive picture will help us materially in thinking of what we really mean by "exceptional" children.

"Exceptional" Children.

IT seems to be assumed by those who object to child study, that they alone realise the difficulties, and even the possible dangers, of the work, both as regards the child and the observer. This is as if one should suppose that the landsman who stays on shore because he knows that the sea has dangers, thereby exhibits more wisdom and skill than the sailor who faces those dangers and overcomes them through his knowledge of them. One is reminded of this view of the question by reading the paper by Dr. W. B. Drummond, author of *The Child: His Nature and Nurture*, in which he deals with the preparation required for the successful study of children, and the difficulties and dangers which surround the work. Dr. Drummond, himself a skilful observer and student

Difficulties of Child Study.

Next Month:

THE BUXTON CONFERENCE.

Illustrated.

of childhood, considers biology the first study requisite as a preparation for child study, and ranks it even before psychology. In this he is thoroughly sound, for the treatment of childhood has been too much psychological in the past. A little wholesome attention to and care for the physical aspects of the child will surely do more than anything else to put the study on its proper plane, and in its true relation to education.

THE chief danger to the observer, all are agreed, is that the scientific interest should usurp the place of the interest which arises from human sympathy. There is no reason why it should. The lover of flowers may and does become a student of flowers, if he is wise, as well as the botanist whose interests are wholly in the line of dissection and classification. To the child the danger lies in the fact that his being observed may develop self-consciousness, with all its disadvantages. This danger exists in inverse ratio to the skill and experience of the observer, and if those qualities are sufficiently developed, the risks practically disappear. Incidentally, Dr. Drummond gives a very useful review of what the chief problems to be solved by child study really are.

Its Dangers.

We commend this little periodical to the notice of all teachers who take any interest in the matters discussed in these paragraphs from time to time.

THE CONFERENCE TOWN.

BUXTON.

BY JOHN W. SOUDEN,

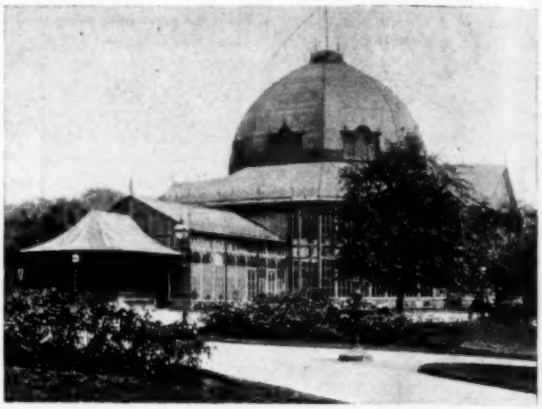
Treasurer, General Conference and Executive Committee; Secretary, Publishers' Exhibition Committee.

"Buxtona, quæ calidæ celebrabere nomine lymphæ,
Forte mihi posthac non adeunda, vale!"

SO wrote Mary, Queen of Scots, on a pane of glass in her room at the Old Hall—now the Old Hall Hotel—on the occasion of her last visit to Buxton in 1582.

"Buxton, whose fame thy milk-warm waters tell,
Whom I, perhaps, no more shall see, farewell!"

The hapless queen visited Buxton several times in charge of the Earl of Shrewsbury, and apparently received much benefit from the waters. In a letter she mentions: "It is incredible how it has relaxed the tension of the nerves, and relieved my body of the dropsical humours with which, in consequence of my debility, it has been charged."

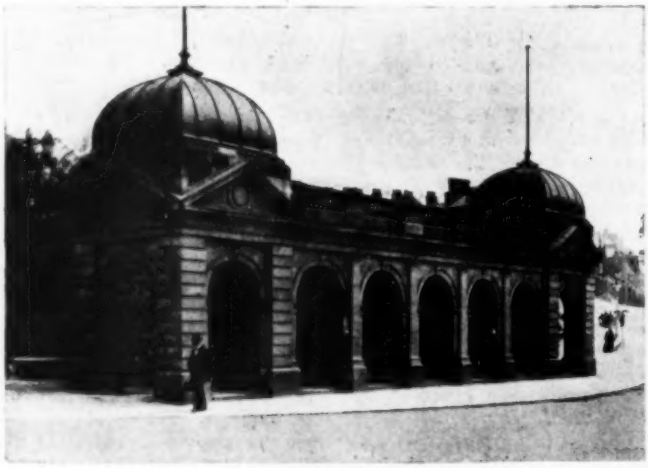


THE PAVILION.

Buxton, however, had been famed long before the Tudor period. At Arbor Low, a few miles from Buxton, are some Druidical remains second only to Stonehenge. There are about thirty stones in a circle with a diameter of fifty yards. Surrounding these is a deep ditch, outside of which is a mound or vallum. There are two entrances to the sacred circle, exactly north and south. These remains will well repay a visit; and whilst the delegate is musing on the barbaric times, he will appreciate Howitt's thoughts when

"In twilight silence and alone
I've sate upon the Druid stone,
The visions of those distant times,
Their barbarous manners, creeds, and crimes
Have come, joy's brightest thrill to raise
For life's blest boon in happier days."

There are ample proofs that Buxton was well known in Roman times. Traces of ancient baths and other buildings have been discovered, and a milestone, now in the museum at Derby, places the Roman camp at Brough as "XI or XII" miles from Buxton. Mr. Jewett is of opinion that at least seven old roads diverged from the town. The one leading to Brough, near Hope, is still called Bathom Gate, or the Bathway. Another well-defined road ran to Manchester, being known *en route* as High Street, Old Gate, Street Lane, etc.



THE PUMP ROOM.

History often repeats itself. What may have been the motive of the Romans in pitching their tents near medicinal springs such as Buxton and Bath is doubtful—whether luxury, superstition, or health. One almost is tempted, therefore, to ask why our delegates at Bristol last year should so decidedly favour Buxton, when Blackpool, Southport, and Morecambe woo with such fervour, and yet unsuccessfully!

Again, later, in the superstitious Middle Ages, we find pilgrims from far and near visiting the shrine of St. Anne's, and leaving their offerings behind in the form of crutches and sticks. However, the sturdy Protestants of the Reformation period had all these broken and burned. In a Latin poem of the latter end of the seventeenth century, Thomas Hobbes informs us that

"Unto St. Anne the fountain sacred is,
With waters hot and cold its sources rise,
And in its sulphur veins there medicine lies;
This cures the palsied members of the old,
And cherishes the nerves grown stiff and cold;
Crutches the lame unto its brink convey,
Returning, the ungrates fling them away."

One of the best-known writers on Derbyshire lore and its scenery is "Strephon," Mr. Edward Bradbury. There is none of the usual guide-book flavour about his writings. Should there be a rainy evening during Conference week—and it does *occasionally* RAIN at Buxton; one of the penalties

IN THE GARDENS.

of living in such an "elevated" position!—the delegate would be able to rid himself of *ennui* by dipping into his *Pictures of the Peak*. His graphic descriptions, his character delineations, wit, humour, and satire, make it one of the most readable books of its kind. With the talented author's permission, we quote the following on Buxton one hundred years ago:—

"Some places are analogous with people. They have their youth and manhood, their ripe old age and tottering decay. As with the individual, so with the town. It is a story of rise and progress, prosperity and opulence, decline and fall. Some towns, however, reverse this rule. As they grow older they become younger, and advancing years only bring with them higher spirits, brighter looks, increased powers, and more vivacious vitality. Buxton was a sanatorium of the Roman legions when Jesus of Nazareth was preaching the Sermon on the Mount. It was a place of established reputation before the existence of some modern cities, and when great manufacturing centres, with their teeming, toiling populations, remained unreclaimed from moss and marsh and moor. Yet Buxton is younger to-day than it was when Mary, Queen of Scots, counted her rosary at the Old Hall, and those foppish courtiers, Leicester and Burleigh, in slashed and puffed doublets, velvet cloaks, and jewelled belts, drank the waters, and strutted with swaggering gait on the bowling-green. Two thousand years ago the Spa of the Peak was in its teens. Unsightly tenements have been replaced by handsome buildings, and unsavoury alleys by spacious thoroughfares. Some picturesque old edifices have been demolished—quaint, half-timbered, lattice-windowed, high-gabled 'bits' of architecture, gray with age, and wrinkled with russet reminiscences—that an artist would have spared; but comfortable cottages have succeeded cave-dwellings, and tumble-down houses have been 'improved off' to make way for elegant villas and imposing terraces, great hotels and halls of health. An old, grubby limestone chrysalis has been metamorphosed into the brightest of architectural butterflies. The translation has been a protracted one, for the Peak District is famous for its 'fossils,' and the petrifying process sometimes congeals mind as well as matter. In the reign of Beau Nash, Bath was a more fashionable residential place than Buxton is in the ninth decade of the nineteenth century, and its buildings were quite as pretentious, thanks to the genius of Wood, an architect who made artistic use of natural advantages. In the time of the Tudors, however, Bath was more celebrated for its wool than its waters; while Buxton was the Mecca of pilgrims from all parts, who were attracted by the medical fame of St. Anne's Well.

. . . . . .

"The pump room of a hundred years ago compares very favourably with the shabby apology for such an institution that exists to-day. The springs bubbled up in sparkling purity into glistening marble basins, and there was an absence of the vulgar public-house beer-handles that 'decorate' the counter of the present meagre apartment which is deemed good enough to receive the visitor accustomed to the superb pump rooms and kursaals of the Continent. St. John's Church, with its *hôtel-de-ville*-like exterior, and Turkish-bath-like ceiling, was not erected until 1812. A century ago the hotels competed with the tottering chapel of St. Anne's in offering spiritual edification to Buxton visitors. A clergyman, the Rev. Mr. Thorpe, attended daily at the Old Hall, saying grace and reading prayers. He was well paid for his pious pains. 'As a reward for his trouble, when the cloth is removed, and he has left the room, the principal gentleman at the table goes round with a plate to the company, who give what they please, never less than one shilling, and a few more a "piece," which amounted generally to four pounds.' Think of that, churchwardens of St. John's and St. James's, when all the preaching of the most powerful pulpiteers cannot extricate your funds from debt. But it was not all sermons and soda water at Buxton a hundred years ago. The visitors gambled as much as they did at Bath during the regency, and the preponderance of people who subscribed for the card-room over those who supported the church gave rise to the satirical lines,—

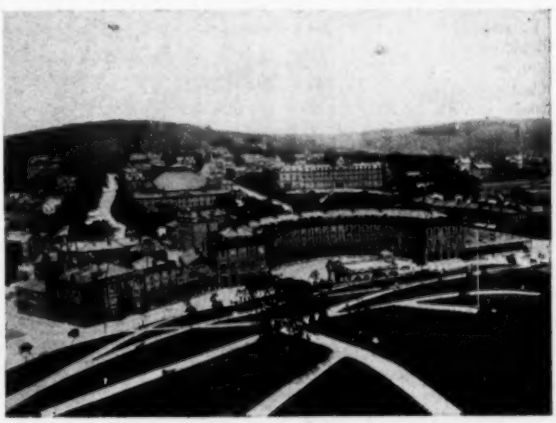
'The church and rooms the other day
Open'd their books for prayer and play;
The priest got *twelve*, Hoyle sixty-seven:
How great the odds for hell 'gainst heaven!'"

Here follows an eloquent description of a dance at the Assembly Room in the Crescent, peopled "with the phantoms of the past."

"Music floats in the air. It is a stately minuet. There is a ripple of laughter in the intervals, and everybody seems to be talking to everybody else. The music starts again, and there is the *frou-frou* of silk and brocade on the ball-room floor. I should like to join the dancers; but I must first go home and array myself in a full-skirted, murrey-coloured coat, don a flowered waistcoat, encase my legs in breeches of sarsenet, put on my silk stockings, comb my bag wig, and further adorn my person with fine lace ruffles and a jabot. But what is the use of these vanities? The gay company upstairs have long gone home. It is only the wandering shadows of a hundred years ago that haunt the Crescent to-night."

Buxton To-day.

The delegate has the choice of travelling either by the Midland or London and North-Western, both companies having an excellent service of trains. The stations, which are the termini of their respective lines, are close together. On leaving the platform, the visitor will notice on his right a magnificent building surrounded by extensive grounds.



THE CRESCENT.

This will be the headquarters of the Executive—the Palace Hotel. Facing him is the post office, which will shortly move into more commodious premises across the road. A pile of buildings, with an immense dome, is a striking feature near the Palace Hotel. This is the Devonshire Hospital.

Here hundreds of poor patients yearly receive gratuitous medical advice and assistance, and in most cases obtain relief from their rheumatic pains. The dome is said to be the

ASHWOOD DALE.

widest in the world, and under the centre a remarkable echo is heard. Should the delegate exclaim, "Will you have a drink?" the reply, "Begorra, I will," will *not* be heard, as tradition says occurred at an Irish tourist centre.

Near at hand is the Pavilion, with its magnificent gardens. The grounds, some of the finest in Europe, were laid out by a limited company in 1870. The Conference will be held in the large hall, and it is claimed that this will compare favourably with any previous Conference room. The entrance to the Pavilion is by a long covered promenade, which expands midway into a large central hall. Part of the publishers' exhibition will be held here. The new opera house near the entrance will attract the visitor's attention. It was hoped that this truly magnificent structure would be completed by Easter. However, the best-laid schemes have as usual gone awry, and it is proposed now to open it at Whitsuntide. The present theatre near the Conference hall will be probably used as a buffet and reading-room. A London company will occupy the boards in "A Bishop's Move" during Easter week. Mr. J. Willoughby, an old "Culhamite," has been the popular and energetic secretary to the Gardens Company for many years.

The river Wye flows through the gardens, and is crossed by several rustic bridges. During the intervals between the sessions, the delegates will not only have the opportunity of enjoying strolls through the delightfully laid-out grounds—flower-beds, shrubs, and shady seats abound in every direction—but there are also several lawn-tennis courts (grass and gravel), croquet lawns, a lake for boating, a bowling-green, and a covered skating-rink. During the season a first-class band, under the conductorship of Mr. De Jong, plays daily at 11 a.m. and 7.30 p.m. Mr. Burgess, an extremely able and well-known musician, gives organ and pianoforte recitals in the afternoon. During the winter months a smaller band occupies the central hall morning and evening.

On the south side of the gardens is the Broad Walk, *the* promenade during the season. Ascending the Terrace Road, on the left is situated the Town Hall, a comparatively modern building. Standing immediately in front, we have the finest view of the district. Facing us is the Crescent, a Doric pile of buildings, erected in 1780 by a former Duke of Devonshire. It has a curve of 70 yards, and is occupied by the Crescent and St. Anne's Hotels.

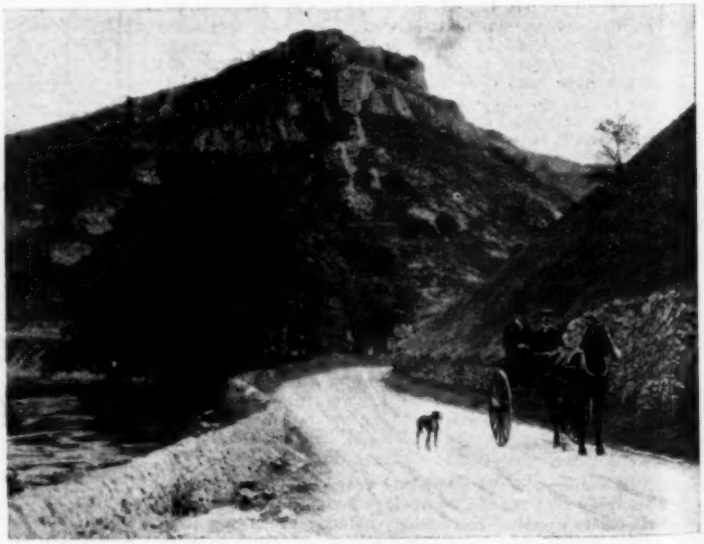
The hot baths are at the east end, and the St. Anne's Well, the natural baths, and the chalybeate springs at the opposite end. The Old Hall Hotel adjoins the natural baths, and here Mary, Queen of Scots, resided, as mentioned at the commencement of this article. To the right can be seen the railway stations, the Palace Hotel, Devonshire Hospital; on the left, the Gardens, Pavilion, and St. John's Church. One catches a glimpse, too, of the new Empire Hotel, belonging to Messrs. Spiers and Pond, which was opened two years ago, probably the finest in Buxton. It is closed from October to May, hence the "dividends" have to be made between Whitsuntide and the end of the season!

The background of our panorama is particularly fine—Corbar Hill and Woods facing us, Coombs Moss and Blake or Black Edge* to the right. In the distance the suburb of Fairfield can be seen, with its recently restored church, dedicated to St. Peter.

It might be mentioned here that the river Wye divides the two parishes of Fairfield and Buxton, hence most of the finest buildings, etc., are in the former parish. Though both townships possess separate urban district councils, it is hoped in the near future that local prejudices will be overcome, and the authorities unite to apply for one charter of incorporation. A mayor and corporation will then be able to welcome Conference on the occasion of its *next* visit to our interesting neighbourhood, though we doubt not the genial chairman of the Buxton Council and his colleagues will form efficient substitutes at the present.

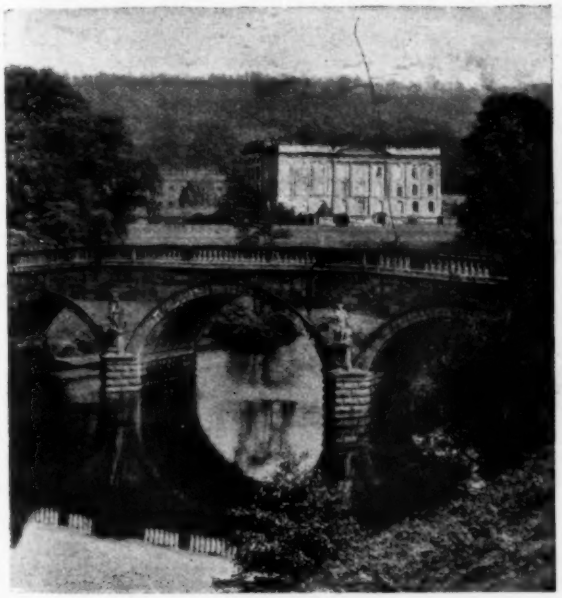
The chief attractions, however, from a scenic point of view, do not lie in the township itself, but in the surrounding country within a radius of a dozen miles. Buxton has never

* H. W. Wager, Esq., H.M.I. of Schools, an authority on botany and biology, mentioned to me the other day that he considered a ramble on Coombs Moss and Black Edge was the finest and most interesting in the district. Pansies and other wild flowers abound in summer.



SOPLEY PIKE.

catered for the ordinary day tripper, though on Saturdays during the season hundreds pour in; yet those bent on seeking enjoyments such as Blackpool and similar pleasure resorts provide return home bitterly disappointed.



CHATSWORTH.

The following favourite walks and places worth seeing are close at hand.

Taking the Crescent as a centre, we proceed up the Broad Walk, and pass the Buxton College, the most important secondary educational establishment of the district. During the principalship of the present head-master—Dr. Little—it has become an extremely popular and prosperous "county" school. Near at hand is Poole's Cavern and Museum, once the retreat of a famous outlaw named Poole. It is one of the most interesting limestone caverns in the neighbourhood, rich in stalagmites and stalactites. Their forms have suggested their names—for example, Flitch of Bacon, Font, Beehive, Lion, Mary Queen of Scots' Pillar, her Majesty having, the guide informs us, proceeded to this point. The cavern is over 700 yards long, and well repays a visit.

The hill on the left is Solomon's Temple, its name derived from a former owner of the farm on its summit, one Solomon Mycock. A round tower was a few years ago erected on the highest point, from which a fine view of the town and district is obtained. Proceeding, we reach Burbage, a pretty suburb, where most of the male inhabitants are engaged in the limeworks. The blasting of the rocks, whereby immense masses of two or three thousand tons are detached, the burning of the limestone, and the enormous heaps of refuse, are worthy of notice. We may return to Buxton by the Middle Road or by St. John's Road.

Fairfield lies in the opposite direction. Passing along Spring Gardens and Fairfield Road, we reach a fine expanse of open common. This tract of over 100 acres must remain "unenclosed for ever." The Buxton and High Peak Golf Club utilises this as part of its famous course. The common —or to give it its ancient name, "The Barms"—is used for grazing purposes, horse riding and exercising, and last, but not least, as the playground for children attending the Endowed Schools. Standing 1,000 feet above the sea, one cannot imagine a more healthy and invigorating spot.

If, instead of proceeding to Fairfield, we turn to the right at the north end of Spring Gardens, we have a delightful walk "down the Dale," perhaps the most popular and interesting walk in the district. The Buxton sewage works, gas and electric-lighting works, are necessary "blots on the landscape;" but passing these, we soon reach "Lover's Leap." From this spot to Miller's Dale—a distance of six miles—we pass alternating scenery of river, road, railway, ravine, and rock.

Opposite the gas works we may leave the main road and proceed along the Duke's Drive, pass Sherbrook Dale—a charming spot—and turning here to the right, reach Higher Buxton by London Road. The ascent to the left leads to Harpur Hill, noted for its enormous quarries and limekilns, belonging also to the Buxton Lime Firms Company.

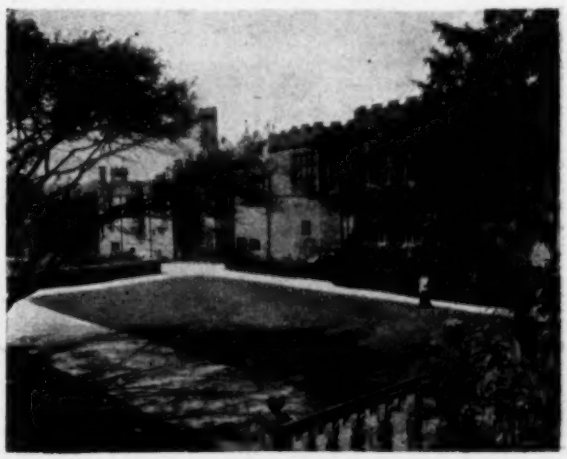
If the delegate desires to go farther afield, perhaps one of the finest walks is along the Goyt Valley. Passing through Burbage, we proceed along "The Old Road" for about three miles, and reach the source of the Goyt. It rises in Axe Edge, the summit on our left, the second highest point of the Peak District—Kinderscout, near Hayfield, being its successful rival.

Two miles before us is the "Cat and Fiddle," jealous of its reputation as being the highest inn in England.

However, we follow the river to the right, and the scenery in the first part of its course is equal in grandeur to any in the district, and is both Norwegian and Alpine in character. The course of the stream lies between large tracts of moorland. Passing a disused quarry, from which in bygone days the paving-stones of Regent Street were obtained, we reach a plateau, and an entrancing view of the valley is obtained. The river lies a hundred feet below us, and the lights and shades cause it to look like a stream of silver. The road now winds through a pine wood, and with a little imagination the visitor can picture what a delightful scene this is in summer.

Goyt's Bridge—a favourite haunt of artists—is now reached. Errwood Hall, the seat of the Grimshaws, who still cling to the "old faith," appears to our left, and in the season the grounds are visited by hundreds to enjoy a magnificent show of rhododendrons. A beautiful Roman Catholic chapel and mausoleum adjoins the green and bowery domain.

We may now either return to Buxton by crossing the bridge, and proceed up an old, rough, and steep by-road—glimpses of magnificent scenery being obtained *en route*—or still follow the river, which for another five miles winds through scenery altogether different from the first part of its course. Passing through a gate marked "private," we walk down a fine avenue of trees that reminds one of "where twines the path" of Trossachs fame. The powder mills belonging to the Chilworth Gunpowder Company are reached, and we can now join the main or Manchester road, or still follow the river to Taxal and Whaley Bridge. The left bank is high and precipitous, clothed with trees of all kinds; this part is famed for the richness and variety of its vegetation. The right bank is a continuous length of beautiful level



HADDON HALL.

sward. In the writer's opinion, this surpasses in sweetness and beauty the earlier part of its course. It vividly brings to mind Longfellow's description, "Where water slips along o'er moss-grown stones with endless laughter."

The return to Buxton may be made by the L. & N.-W. Fare, 9½d.

The programme prepared by the Excursion Committee is an excellent and most varied one. Visits will be paid to Chatsworth and Haddon, Dove Dale and Hartington, Castleton and its famous mines, Matlock, etc.

The views illustrating this article were obtained from Messrs. Steward and Co. Delegates and others desirous of obtaining a pictorial memento of their visit would do well to call at their studio in the Quadrant.

A TECHNICAL SCHOOL FOR WOMEN.

IT may be a manifestation of the homing instinct—Eve returning to the garden, this time for the definite purpose of cultivating the tree of knowledge and enjoying the fruits thereof—but as we are more interested in education than in the study of heredity in its more obscure forms, we prefer to regard the introduction of gardening as a profession or occupation for women as simply a new form of Technical Education. In England the establishment of Swanley Horticultural College and the work of the Countess of Warwick at Reading have given more than an experimental importance to the study. Already fully-trained lady gardeners are to be found in charge of large gardens, with their staff of assistant workers, or managing market-gardens of their own. The recent training of ladies at Swanley College for such work in South Africa will be in the memory of many of our readers who take a special interest in women's work.

And now it has spread to Scotland. To say that the training of gardeners has spread to Scotland may seem somewhat like the discovery made by a Southern golfer the other day, that golf had now spread as far north as St. Andrews; for in all respectable works of fiction in which a gardener appears he is invariably a Scotsman, and this habit is founded on a considerable amount of fact. The Scotswoman has not yet appeared as gardener in our novels, but she may be expected to make her *début* shortly in that character; she has begun to study the part.

We were assured of this fact the other day when we made a brief but very pleasant and instructive visit to the School of Gardening for Women at Inveresk, near Edinburgh, in order to obtain information as to what such a training included. To visit a garden in February is to take a somewhat mean advantage of it; but it has the effect of leaving the mind free to attend to the educational side of the question, undisturbed by the pleasant sights, sounds, and perfumes, which in summer time might render the visitor less critical.

IN THE VINERY.

The curriculum at Inveresk strikes one as very complete. The full course extends over two years; but students who wish instruction only for their private improvement in the management of their flowers or vegetables may attend for any period that may be agreed on. The practical work includes training in the culture of plants under glass and in forcing-houses, the growing of flowers, fruit, and vegetables in the open, with the practice of bee-keeping and the specially feminine accomplishment of making bouquets. The theoretical study includes attending classes in the principles of horticulture, botany, horticultural chemistry and physics, and entomology, with the addition of bookkeeping. For most of these classes the pupils attend the Heriot-Watt College in Edinburgh.

ARRANGING BOUQUETS.

As a training for girls, this course of practical and theoretical gardening seems peculiarly attractive in this age of nerves and worry—attractive to the educationist, that is to say, if not to the girls. Here, if anywhere, one may "learn to labour and to wait"—the latter fast becoming an extinct art, one fears.

The judicious combination of study with manual work, much of it necessarily in the open air, and the air of a garden at that, amid the corporate life of a college such as John Ruskin might well have endowed with his benediction—such a regime we consider almost, if not quite, ideal for any girl; and if one of the nervous specimens were to attend the college only until she was hardened up to the stage of being able to hive a swarm of bees without screaming, she would have made an advance in real education which would tell for good throughout her whole life, and would enable her to bear with equanimity many things which jar on the undeveloped nervous system. The ladies who preside over the school, however, would possibly demur to our regarding their establishment as a sanatorium for the hysterical. They rightly regard it as being primarily a Technical School for women who propose to earn their own living in an eminently suitable sphere.

We felt during our visit, and we still feel, that a school such as this, in the close neighbourhood of a large city, might be of great service to teachers. We have now awakened, or we have been awakened, to the importance of Nature Study in all our schools, and with this awakening has come the cry for direction as to how we can best introduce our children to Nature. We are all agreed that the study of plants must have a prominent place in our course

of lessons. The traditional botany is not quite what children need. The teacher must know botany, but she must not attempt to teach it to her class; the scientific point of

CUTTING PINKS.

view is not for children. The ideal thing for them would be to grow and take care of plants as living things. Town schools have no space for gardens, and town-bred teachers would not always be able to make the most of them if they existed. With a little practical skill in horticulture added to the zeal which all teachers possess in abundance, every school window might become a school garden, and Nature be brought within doors for the children to observe. Much of this is done already, but some systematic training would vastly increase its possibilities, and such a line of study would be much more valuable for the teacher of Nature Knowledge than a very full course of botany from the merely scientific side. We can imagine nothing more helpful to the city teacher than a short course of practical lessons at this college, and no more pleasant way of spending a few Saturday mornings, or a part of the summer holidays. There is in the meantime no provision for such classes in the school, but no doubt if a demand were made for them the supply would be forthcoming.

AMONG THE BEES.

We are enabled to reproduce a few photographs of students engaged in practical work, which will be of some interest. We should also mention that the present premises, which form part of a market-garden, are to be vacated immediately in favour of a site on the slope of the beautiful Corstorphine Hill, where glass-houses are now being erected with a special view to educational purposes, in order to afford experience in all forms of culture; and with its more perfect equipment, the school will doubtless enter upon a career of increased usefulness and prosperity. We are convinced that it has great possibilities for education in several aspects; hence this short article.

SUPPLEMENTARY COURSES IN DAY SCHOOLS.

CIRCULAR BY SCOTCH EDUCATION DEPARTMENT.

THE Scotch Education Department have issued a most important circular bearing on the question of what is the most suitable curriculum of study to be followed, in the interval between obtaining the merit certificate and leaving school, by those pupils who may be expected to be withdrawn at fourteen years of age, the minimum age allowed by the Education (Scotland) Act, 1901.

This period, it is admitted, would be usefully employed if it were devoted solely to revising the work already done in preparation for the merit certificate examination. But such revisal would be irksome to teacher and pupil alike, and the consequent loss of interest and absence of stimulus would result in defeating the object aimed at. The extension of school age would be of no educational advantage if this restriction were made.

Again, the study of distinctively secondary subjects—for example, a language, ancient or modern, or geometry treated deductively—might have a certain disciplinary value; but this implies a new departure from previous studies, and the time for their effective study for any practical purpose is too limited. These subjects are therefore not to be made a necessary element of the ordinary school curriculum.

The Department are of opinion that the tendency to make one and the same school, with one and the same staff, serve many different functions, is the weak point of Scottish educational organisation. They urge, therefore, that the exceptional pupils for whom instruction in secondary subjects is desired should be transferred early, say before twelve years of age (the age at which the merit certificate can be obtained). This could easily be accomplished in towns and populous districts, and would be to the advantage of the pupils. In rural schools they recognise that transference is difficult or impossible. For the sake of those pupils who, having reached a certain well-defined stage of general education, will not enter upon the study of the specifically secondary subjects, they propose in the main a

Continuation and Development of their Previous Studies.

To this end they propose the following supplementary courses:—

1. Preparation for Commercial Pursuits — Commercial Course.

2. Preparation for Manual Occupations and Trades —Industrial Course.

3. Preparation for Rural Life — Rural Schools Course.

And for Girls—

4. Preparation for Domestic Duties — Household Management Course.

The object of these courses is mainly to give a certain definition and sense of reality to the ordinary work of an elementary school. But school work has for its end objects more important than preparation, in the narrow sense, for any particular occupation; it aims at the production of useful citizens, imbued with a sense of responsibility and

of obligation towards the society in which they live. It should render the pupil fit in body and alert in mind, and prepare him for the rational enjoyment of his leisure time, as well as fit him for earning his living. Accordingly the general instruction given should embrace:—

(1.) Study of English. This would endeavour to create a taste for good literature, give the proper direction as to choice of books for home reading, and embrace the systematic teaching of English composition.

(2.) Certain general studies bearing upon the future occupation of the pupils, and should include—

(*a*) Hygiene.

(*b*) Knowledge of institutions, of government, the history and growth of empire, the colonies and openings for enterprise, the direct knowledge of their own neighbourhood, historical monuments, and of the machinery of local government.

To these may be added nature study and drawing.

In the supplementary courses the pupil who is to be more or less his own master at fourteen years of age should be looked upon as a student studying under direction certain subjects for ends which he himself, in some degree, realises and desires. Self-reliance should be fostered, a sense of responsibility inculcated, and to this end the pupil may be assigned a position of honour in the exercises common to the school. Thus would there be a development of character and a fostering of a healthy *esprit d'école*.

In rural schools the study of these pupils will be largely individual. The pupil will be concerned with the application in fresh directions of studies in which he has already received some grounding. Direction, guidance, and explanation when necessary will take the place of continuous instruction. In country schools it may be preferable to follow the industrial course. The girls should receive special instruction in needlework and cutting out, and it is much to be desired that County Councils or Secondary Education Committees should employ well-qualified teachers of cookery, laundrywork, or needlework to give some instruction in these schools.

In rural schools the supplementary courses may serve the purpose of classes under the

Continuation Class Code.

These courses would offer an opportunity for more continuous, more prolonged, and better organised study.

In town schools it is recommended that the same district should endeavour to provide within itself

A Triplicate Course

—for example, a commercial, an industrial, and a household management course, when, by a proper organisation and subdivision of labour, each separate course might be assigned to a separate school. For this reason the elementary schools of a given town area should not be regarded as separate entities, but as parts of the same organisation, thus permitting a free interchange of pupils at the stage at which the special studies of the supplementary courses are entered upon. Among the suggestions for carrying out the method of study proposed, the Department are of opinion that great use might be made of the daily newspaper as a starting-point. Analysis of the shipping returns for a given port might be made. This would lead to a knowledge of its trade, its position, and information should then be gathered from school geography, gazetteer, or encyclopædia, and this information should be set down in well-digested and orderly form. Historical allusions in leading articles, etc., would form the occasion for reference to other sources of information, and for the collateral reading of authorities. For this purpose every school should be equipped with a proper set of reference books—for example, a standard dictionary (etymological), a reference atlas with index, various historical books, a hand-book of European history, a biographical dictionary, a dictionary of dates, and one or more of the comprehensive year-books now issued. A lending library of carefully selected books of literature should be possessed.

The grant for these courses is to be 50s. per pupil, in accordance with Article 21, and special payment for manual occupations, cookery, laundry, etc. As a result of all this, the merit certificate is to be put on a proper basis, and will be preceded by a qualifying examination, designed to secure that the pupil entering upon the supplementary courses shall have reached a sufficient stage of advancement in the general range of studies of the elementary school. No certificate is to be issued for this preliminary examination. The merit certificate will now be given on leaving school, and will take account of the work done in these new courses.

The specialised instruction is to be on the lines of the Advanced Continuation Classes.

I. Commercial Course will include:—

1. The principles of arithmetic, and expertness in making calculations. Concrete cases, such as actually occur in business transactions, are to be taken. The use of a ready reckoner may be allowed. Decimal notation is to be taught.
2. The principles of bookkeeping.
3. The purpose and proper form of common commercial documents—for example, invoices, accounts, receipts, cheques, etc.
4. Systematic exercises in handwriting.
5. (Optional) Shorthand.

II. Industrial Course will include:—

1. Geometry and mensuration; the correct use of mathematical instruments.
2. Applied arithmetic.
3. Money calculations.
4. Workshop practice.
5. Simple principles of mechanics—for example, building construction, or machine construction and drawing.

III. Rural Schools Course will include:—

1. Special instruction relative to agriculture and horticulture. School gardens might prove a valuable adjunct. The influence of manures, etc.; rocks and soils of neighbourhood; life histories of weeds and insect pests; wind and insect pollination of plants; systems of bee-keeping; rudiments of chemistry.
2. Subsidiary subjects—
   (*a*) Instruction in geometry; land measurement.
   (*b*) Newspaper reports on markets, and calculations based upon them.
   (*c*) Keeping of accounts.

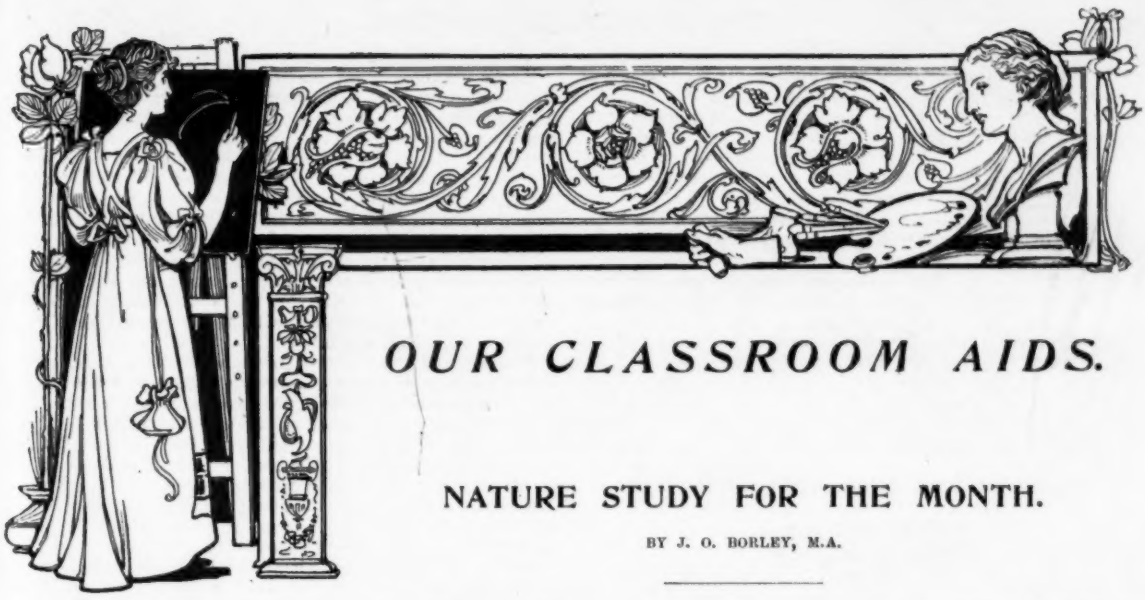
IV. Household Management (girls' course) will include:—

1. Essential branches of housewifery: housekeeping, furnishing, clothing, marketing, cookery, laundrywork, needlework, especially mending, darning, and cutting out.
2. Subsidiary subjects—
   (*a*) Applications of arithmetic.
   (*b*) Practice in scale drawing.
   (*c*) Dressmaking and the use and care of sewing machine.

COURSE FOR SECONDARY TEACHERS AT THE LONDON DAY TRAINING COLLEGE.—The Board is prepared to grant free admission to the course for secondary teachers at the London Day Training College to a limited number of applicants resident within the Administrative County of London who can show, to the satisfaction of the Board, that they require assistance in order to enable them to go through the year's course. Candidates for admission to the course must have taken their degree, or have been through a course of study and passed examinations equivalent to a degree. The course will commence on 14th January, and candidates will be required to present themselves for the examination for the teacher's diploma in connection with the London University in December 1903.

Applicants for free admission to the course should communicate as soon as possible with the Secretary of the Technical Education Board, 116 St. Martin's Lane, W.C., giving particulars as to their educational qualifications and their financial circumstances.

THE twelfth General Conference of the Teachers' Guild will be held at Plymouth from 21st to 24th April. The Assembly Rooms of the Royal Hotel have been engaged for the purpose, and the conference will open with a reception on the evening of Tuesday the 21st. Among the subjects for discussion we notice:—"The Essentials of a School Curriculum—(*a*) for Boys leaving School at sixteen to seventeen years of age, (*b*) for Girls leaving School at sixteen to seventeen years of age;" "The Essential Principles of Educational Handwork;" "At what Stage or Stages should Nature Study become (*a*) Botany and (*b*) Physical Science respectively?" The conference will conclude with a concert and excursions to places of interest in the neighbourhood of Plymouth.



OUR CLASSROOM AIDS.

NATURE STUDY FOR THE MONTH.

BY J. O. BORLEY, M.A.

IT will be well to confine our attention this month to natural history. The weather should be more favourable for outdoor work than hitherto, and the coming of spring repeoples the country with plants and animals dormant or absent during the winter.

Certain considerations spring from our subject-matter, consisting largely of living animals, which may be mentioned as a preliminary. The first is the advice to keep them living. To all, especially to children, a living animal is intensely more interesting than a dead one. It moves; it, therefore, is not monotonous to observe, because it is changing, even if only changing its place. It is as living animals, moreover, that the children will meet with the creatures when not at study. As far as possible, too, give the animals kept natural surroundings; far more can then be learned of their habits.

Lastly, since the work involves inquiry into structure, it will be necessary sometimes to kill animals. If the effect of the lessons is to be above reproach, this needs some thought. Some children are more callous to animal suffering than the average grown-up, who is by no means hypersensitive on such points; and while knowledge of delicacy of structure, say of an insect, knocks away one support of callousness, ignorance, and often another, namely, repulsion, yet open carelessness of suffering may do a deal to perpetuate in the child's mind any bad feelings originally there. A little experience will show these remarks not superfluous. It is well, for instance, to entrust killing-bottles, etc., to older children only, and to prepare beforehand specimens required for younger classes. It seems but reasonable, it may be added, to think that direct study properly conducted gives the best means of arriving at a justly-proportioned grasp of this matter.

To proceed now to practice. At the beginning of April frogs' spawn may be found about the margins of ponds and ditches, water snails have now emerged from the mud at the pond bottoms, and newts appear in the water, having, like the frogs, hidden beneath stones, etc., during winter. An easy way of observing these animals constantly is to start a small aquarium, or better, two or three small ones. Any glass vessel will serve, so long as it has a widely-opened mouth, and sides clear enough to allow of observation.

If specimens cannot be procured by collection, they can be bought from the dealers, one or two of whom can nearly always be found from their advertisements in *Nature* or some such periodical. Some of the mud from the pond from which the animals were taken should be put in, and a few pond weeds planted in it—the latter being a most necessary condition of success—before the aquarium is filled. It may be added that though space forbids any detailed reference to appliances, a net of muslin, mounted on a strong ring firmly fixed to a longish stick, is the most generally useful tool for pond work.

The success of an aquarium very largely depends on striking the right balance between the animal and plant inhabitants: the former absorb oxygen, and give out carbon dioxide gas; the latter during day have just the reverse effect, and so keep the water oxygenated. It is not very difficult to make these almost exactly counterbalance. A more usual difficulty is that of food. Avoid having an excess, as it decays and poisons the water. A bell jar has for many months accommodated three minnows and a few pond snails, besides smaller fry, when supplied with about three inches of thread of vermicelli each day. Recently the snails spawned; and Fig. 1 represents a mass of spawn on a small floating weed from this jar. It has been sketched for

FIG. 1.

the sake of the spawn, and also the weed, as this latter is a very efficient one to keep. A mass of spawn deposited on the sides of the jar enables one to watch with a lens the development of the young snails from the eggs, which are at first perfectly transparent oily-looking droplets; but this by the way.

Developing Frogs.

Obtain frogs' spawn, a mass of eggs, and place in water. If collected, carry home in water. The black spot in the centre of each egg elongates, curves, and at last emerges as a tadpole. Tadpoles are at birth destitute of a mouth. They live by absorbing the gelatinous yolk which surrounds them. When they wriggle free of the jelly, they have a horseshoe-shaped sucker by which they can adhere to any object. They are usually vegetarians as soon as the mouth forms, feeding on decaying vegetable matter, but are in no way particular; and one naturalist, I think Buckland, used to skeletonise the bodies of small animals by putting them into a tub containing tadpoles.

It is a good plan to preserve tadpoles at distinctive stages of development, say in spirit; but preserved or not, new features in the brood should be watched for daily, and a few taken out in a saucer and sketched as soon as a change has occurred. The following gives roughly the sequence of events:—

1. Eggs swell up in water (Fig. 2).
2. Fortnight after eggs are laid tadpoles hatch; already

with three pairs of external gills and sucker, and over one cm. in length.

3. Few days after horny jaws and mouth appear. At same time gill *slits* appear.

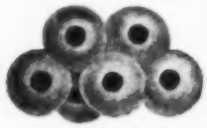


Fig. 2.—Eggs of Frog (First Stage).

4. In the fourth week a fold of skin begins to grow over gills—the operculum (Fig. 3).

5. In the seventh week the buds which have foreshadowed the limbs begin to form joints.

6. In the eighth week the toes begin to form, and the lungs begin to be of use.

7. A few days later the skin is cast—that is, an ecdysis occurs—and the left fore limb appears through the little spout which, after the growth backward of the operculum and its fusion behind with the body, was the sole outlet from the gills (Fig. 4). The right limb tears its way through the operculum. The tail is soon absorbed, and a frog produced (Fig. 5).

Thus, with considerable detail, the tadpole traces in its own

Fig. 3.
Tadpole (First Stage).

Fig. 4.
Tadpole (Later Stage).

Fig. 5.
Tadpole (Last Stage).

person the changes from fish to land animal. A very noteworthy point is the history of the gills. A gill is in essence an organ in which blood can flow over a great surface, with but a thin skin between it and the oxygen-bearing water. The tadpole's first attempt is the formation of an outgrowth, the feathery external gill. This attempt is made also by numerous sea invertebrates. The tadpole abandons it; the fishes abandoned it, if ever they made it. It is possible some at least did so, for their young, as in the case of the skate, sometimes possess it. The second attempt was that of slits, lined by the delicate skin mentioned, proceeding from the throat to the exterior. This was safer, being more sheltered, and, now the throat was complete, in quite as constant a stream of water. This attempt was also that of fishes; and to make the case complete, the fold of skin growing back to finish the protection of the slits of the tadpole has no little resemblance to the operculum or gill-cover of many fishes.

This case of the gills, taken here as a fairly concise one, with many like it, leads inevitably to the conclusion that the frog's ancestors were fishes. Why they ever ceased to be so is of course unknown. There is no real necessity, even now; for the change can be indefinitely deferred by sinking an iron gauze half an inch under the surface of the water, thus preventing the tadpoles from breathing air. The tadpoles grow, but remain tadpoles.

Of the other creatures mentioned, something may be said later. If newts have been obtained, they should not be kept with tadpoles, as they eat them readily. They should be given a stone or other resting-place emerging from the water.

Swallows.

This month swallows appear.

For the study of birds in the open air, swallows form a most convenient starting-point. Their appearance and still more their flight make them easy of recognition; and being fearless of man, few places are too populous for them to choose to dwell in. Study of swallows would be made more effective by a previous lesson on the fowl or pigeon, both to teach the general facts of bird structure, and for comparison. It need not be said that specimens should be obtained or viewed wherever possible. For Londoners, the Natural History Museum at Kensington offers great advantages, as many of the birds are mounted as in natural surroundings.

There are three great branches of the swallow stock—the martin, the swallow or "chimney swallow," and the swift; and on the whole these have been named in ascending order with regard to intensity of the peculiar attributes of swallows. All alike are much on the wing, seldom, if ever, perching except when going to the nest; and when on the wing, all have a similar flight—a few rapid wing flaps, and then a swift, straight swoop, suddenly stopped or diverted, like some small dark body hurled through the air, and glancing or bounding off from an invisible wall. Lastly, all feed on small insects taken on the wing; but the swallow flies better than the martin, the swift better than the swallow, flying more rapidly, with longer swoops, and being on the wing earlier and later.

Martins are small brown birds with black tails, white under surfaces, except for a brown band across the breast. The sand martin and the house martin are so far alike, but the latter has a white patch on the upper surface of the base of the tail. The house martin can often be seen flitting round old church towers, the sand martin in and out of its round-mouthed galleries in some sandstone cliff or cutting. These galleries are, as a rule, about two feet long, bend once, and end, without much enlargement, at the nest. The bird mines the sandstone by strokes of its closed beak, clinging as it does so with its head always towards the centre of the hole.

The "chimney swallows" are more brilliant. They are light chestnut on forehead and throat, steel blue shading to black behind this on the upper surface, blue followed by white on the under side. Another distinctive feature is the outside feathers of the tail, which are of great length. The wings are larger than in the martin's. In the swifts, however, these become enormous. A swift will weigh but an ounce, yet possesses wings of eighteen inches span. Swifts' colours are black, with gray under surface. They lay their eggs under eaves, but do not make such elaborate nests as the swallows do. The latter build nests of clay, put on a little at a time in the morning and evening, the heat of the daytime seeming to dry the clay so rapidly as to preclude operations.

So much to aid recognition. Let us now turn to habits and structure. It is well always to have some central fact round which to group others—some root fact from which the details proceed; and this root fact in the case of swallows is undoubtedly their custom of feeding on the wing.

Every part of the body is fitted for insect hawking. The beak is broad, giving a wide gape, and flat, so that it can grip small objects. The wings are developed so much that the wing muscles often weigh more than all the other muscles together. The tail is greatly developed, to increase the stopping and guiding power, for with such small game many captures are needed for a meal, and one dash must at once succeed another; and in the swift even the toes are only fit for clinging to vertical or nearly vertical surfaces near the nest, since all point forward. The swift even drinks when on the wing.

The kinds of insects used as food are various, but by no means a matter of indifference to the bird, as might be imagined. Thus, for instance, the swift feeds almost entirely on the small beetles which are called cock-tails, and on small spiders, evidently found wafted about by air currents. The cock-tails are distinguished by their power of turning the abdomen back on itself, either when irritated or to assist in tucking the wings below the small wing cases. They range in size from the "devil's coach-horse" figured (Fig. 6) to the barely distinguishable little creatures that cause so much pain to mankind in summer by accidental dashes into the human eye. This selectness of feeding on the swallow's part is important. It limits the scope of their operations, already aerial only, still further, and so accentuates the need for the structural peculiarities noted. It has its part also in enforcing the need for another most interesting habit—namely, migration. Being an active bird, it needs much food—as much as a tablespoonful of food has been taken from one swallow—and there is little doubt that the failure of food in autumn sends the birds southwards.

This fact of migration is so well known to most of us that

we glide over the surface of it without a thought of its mystery. Yet it is a mystery. Birds, apparently in the midst of plenty, gather and depart in the autumn to Africa,

Fig. 6.—Staphylinus or Devil's Coach-horse.

in response to an impulse so urgent that even the half-fledged young are sometimes abandoned; return next spring, separate, and re-enter the same nests, at a time which can be predicted almost to a day.

The mere fact of migration has not been known very long. Even as late as the middle of last century, Stanley tells us, naturalists still lived who put the swallow's re-appearance down to its awakening from a winter sleep. The mistake was natural enough. Many creatures reappear in the spring which could not possibly have left the country in the meantime. Ants and frogs are cases in point. Moreover, these were occasionally found dormant in winter. All this was true of swallows, though these were rarely found; and it was easier to think this rareness accidental than to credit the swallows with a direct flight over the length of a whole continent. However, the swallow's migration was recognised before that of most birds, from the habit the bird has of gathering and flying in large flocks. As early as 1771 Gilbert White had, with his usual insight, formed the idea that it was due to a search for food. This view is supported by the fact that a very typical swallow resident in Ceylon, where insect life is always abundant, does not migrate; and also by the martins, swallows, and swifts making stays in Europe in inverse proportion to their rate of food consumption. Thus the swallow arrives about the second week in April, after the martins and before the swifts; while the swifts leave first in August, the swallows following in September.

Gilbert White also had heard from "Andalusia" that the swallows kept as much to the land as possible, crossing to Africa by the narrow strait—a most suggestive fact, especially when considered together with Weismann's observation that wherever they cross a wide sea, as from Algiers to Marseilles, they follow a band of shallow sea that was in all probability land at no geologically distant date. Migration in the light of this fact looks like a hastily recapitulated version of a more gradual migration from field to field and district to district; and it is generally assumed to be so in reality. For the current explanation of the habit is that the swallows followed southward the conditions of their life, when the cooling of Europe, that bereft us of the tropical animals whose remains we find as fossils, occurred, and are even now flying south and north in pace with the fringe of the region of warmth.

There is still much room for speculation concerning this wonderful little incarnation of ancestral custom that is reaching our shores to-day. Why do the birds not hibernate? Is it because their powers of flight obviate the period of defencelessness by making migration practicable? Why do they fly so far at once, instead of by imperceptible stages? Why do they return at all? They can live in Ceylon and in Senegal unhurt by the climate. Is there in the less zoologically-populated Europe a greater chance of rearing young unhurt? Many such questions remain unsolved. For this very reason, as well as for the directness with which the subject takes us away from the bird itself into the relations between it and its conditions, it has been outlined here as a typical study of nature.

FOR SCHOLARSHIP READING.

HENRY ESMOND.

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NATURE-KNOWLEDGE.

BY JAMES KNIGHT, M.A., B.SC., F.C.S., F.G.S., F.E.I.S.,
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FRUITS.

IN making a systematic study of fruits for treatment in school, it may safely be taken for granted that the average pupil, and more especially the average boy, has already discussed them in one important aspect—their relation to man. While not ignoring such an interesting presentation of the objects under review, it is not too much to ask the young gentlemen aforesaid to consider of what service fruit is to the plant which bears it, and how does it come to be there. Even a junior class will be interested in seeing how the structure and attractiveness, or the reverse, of any fruit bears directly upon the two great ends which every fruit serves—to protect the growing seed, and to give it a good start in life by securing for it the best possible distribution. To these economic considerations a senior class should add the history of our common fruits—their development from the pistil or the female part of a flower to form true fruits, or from this, with the addition of some other accessory parts, such as bracts, involucres, receptacle, etc., to form the so-called "false fruits." A "true" fruit is a fertilised pistil, as a genuine seed is a fertilised ovule. The carpels—those leaves which form the pistil, and more especially the ovary—consist of three layers, and it is interesting to trace these in varying types of fruit. Take a ripe peapod. Open it to see how the young peas are attached to the leaves forming the pod. Then break the pod across: this reveals an outer skin, very thin but fairly tough, seen as a transparent membrane; then a greenish, fleshy portion, which makes up the main bulk of the pod; lastly, an inner lining, next to the peas themselves, transparent like the outer coat, but much tougher. In beans this becomes downy or furry. In any stone fruit—say a plum—the same three layers may be traced. First, there is the outer skin of the plum; then the bulky, fleshy portion; and innermost, the stone, which is really the third layer hardened so as to protect the seed within.

The first object of fruit formation is to protect the young seed. This is accomplished in several ways. The outer layer may be mechanically strengthened or fortified by prickles, thorns, and the like, as in chestnut-burrs; or the fruit may have a bad taste, as in walnuts, unripe cherry, and stone-fruit generally, the bitter, acrid juice of orange-peel, and so on. The very colour of a young fruit is a protection—green in foliage, and turning russet or brown as the leaves fade, finally hardening when these no longer give concealment. The hard, woody shells of indehiscent fruits are another case of mechanical protection.

The second great use of fruits to the plant is to give the seeds their best possible start in life, which, of course, will be found outside the range of soil partially exhausted by the parent plant. Some fruits, like centaurea and wallcress, may be called sling-fruits, inasmuch as they shoot out their seeds, especially when touched by some insect. Dandelion and thistle are familiar examples of seeds provided with parachutes for dispersion by wind; and the same may be said of such winged fruits as those of the ash, elm, sycamore, and lime—indeed most of the forest-trees. The clematis and old man's beard use the feathery style of the pistil as a flying apparatus, while the familiar cotton-grass of our marshy pastures gives another adaptation.

Fruits make use of animals in two ways in which the animal carrier is conscious or not of the part he plays. Many fruits are furnished with prickles, hooks, barbs, brushes, so as to be entangled in the fur, feathers, or hair of any stray visitor; others are sticky, and cement themselves upon insect visitors. The round burrs of robin-run-the-hedge are a familiar case in point: an animal brushes against these, unconsciously transports them to some distance, and rubs them off in passing through the next hedge—the very place suitable for the young plant.

Very commonly, however, the plant bribes the animal, offering food in return for carriage. A bird pecks at a sma'l

stone-fruit, carries it off, pecks away the soft, fleshy part, and leaves the hard endocarp containing the seed; or it swallows the fruit whole, as in the case of haws, digests the soft portion, and ejects the indigestible stone—in this case giving not only free carriage to a considerable distance, but a small stock of manure to start the young plant.

The following table presents at a glance the usual forms of "true" fruits, and will be useful for those who wish to follow the usual botanical lines:—

TRUE FRUITS are—

	Indehiscent—*i.e.*, retaining their seed;		or Dehiscent, opening to release their seed.
	One Seed.	Many Seeds.	Capsules of various forms, all dry and many-seeded.
Dry.	Achene. Caryopsis. Nut.	Schizocarp.	Follicle. Pod. Siliqua and other capsules.
Succulent.	Drupe or stone-fruit.	Berry.	

Another line of treatment, with more economic bearings, is the following, taken from the author's *Food and its Functions* (Blackie, 2s. 6d.), where specific information will be found on fruits as foods. They naturally fall into seven classes:—

1. The pip fruits: apple, pear, medlar, quince.
2. The lemon class: lemon, orange, lime, citron.
3. Stone fruits: the drupes of botanists.
4. Berries: mostly acid, such as gooseberry, currant, etc.
5. Fleshy fruits, like the strawberry.
6. Pine-apple, fig, banana.
7. Nuts of all kinds, whether botanically so or not.

This is a shop or table classification. The more orthodox and scientific table is given above.

An achene is formed by a single carpel, and contains one seed. It is found in such common flowers as the buttercup, pilewort or lesser celandine, coltsfoot, and daisy. The so-called "seeds" on a strawberry are really the fruits in a botanical sense, little achenes seated on the swollen and fleshy cushion or receptacle. In a caryopsis the pericarp is united to the seed proper, as is seen in corn, wheat, and all the grasses. Examples of true nuts, which are one-seeded as a rule, will be found in acorns and beech-nuts; in both cases the nut is surrounded by an involucre or leaf-wrapping. Schizocarp is the term applied to those many-seeded fruits which split into simple one-seeded portions, and examples will be found in hemlock, parsley, and all the Umbelliferæ, as well as in the winged fruits (sometimes called samaras) of ash and sycamore. The drupe is our familiar stone-fruit, generally one-seeded; though the buckthorn fruit has two stones with a seed each, and the so-called elderberry is really a drupe of from two to four stones with one seed each. Examples of this are common, from the peach, plum, and cherry down to the humble haw. A raspberry or bramble really consists of a mass of small drupes on a somewhat swollen receptacle, from which the ripe fruit may be lifted clean off. The general structure of these stone-fruits is familiar—an outer skin, a fleshy mesocarp or middle layer, and a hard, stony endocarp containing the seed. An interesting variation is supplied by the cocoanut complete, which shows a white outer skin; then the middle layer, which in this case is fibrous and forms the husk; lastly, the stone, or cocoanut as generally sold. Attention should be called to the three little holes for the liberation of the embryo, and also to the food-store within the seed proper, intended to give the young plant a good start.

Grapes, gooseberries, and tomatoes illustrate the botanical "berry." Nelson's illustrative diagrams of plant life (the best thing of the kind in the market) give useful sections of these and other typical fruits, so as to show the relations of the seeds. Scholars will have already observed the popular extension of the term "berry," and a useful lesson might be given on various berries which are botanically distinct—for example, gooseberry, raspberry, strawberry, elderberry, and blackberry.

Dehiscent fruits (those which open and disperse their seeds) are all capsular, and many of them are very familiar. Marsh marigold is an example of the follicle, a single carpel doubled over. Legumes or pods are illustrated by peas, beans, laburnum, and many others. A siliqua is a pod with a false partition up the centre, and is shown in wallflower, cabbage, and the Cruciferæ generally; while in honesty (*Lunaria*) the large transparent winglike partitions are often preserved for mantel ornaments. Poppy, foxglove, and periwinkle are familiar examples of other forms of capsule.

The children should also be taught the origin of such common "false" fruits as strawberry, apple, hip, fig, and pine-apple. Scott-Elliott, in his *Nature Studies: Plant Life* (Blackie, 3s. 6d.), gives a table useful in this respect, from which the following examples are quoted:—

	Flesh developed from	Seedling protected by
Apple.	Entire wall of inferior ovary.	Seed-coat.
Orange.	Inner lining or carpels, superior ovary.	Seed-coat.
Plum.	All parts of single carpel, except the inner lining.	Inner lining of carpel (the "stone").
Grape.	Entire wall of carpel, superior ovary.	Seed-coat.
Strawberry.	Stalk part or receptacle.	Carpel entire.
Pine-apple.	Whole flower-head, flowers, bracts, sepals, petals, etc.	Seed-coat.
Banana.	Inner lining of carpels, inferior ovary.	Seed-coat, often absent.

By way of showing how the scientific and economic aspects of fruits may be combined in an observation lesson, the following outline is given of an object lesson on the orange, given to a third-standard class in two sederunts of half an hour each:—

Materials required: two common oranges, a Jaffa orange, a Tangerine, a marmalade orange, a lemon, piece of orange peel, and a spirit-lamp. Take up a common orange, call attention to its colour, and exhibit (for comparison) lemon and Tangerine. Next examine the shape: not quite spherical, but flattened at what may be called the "poles." Look where the stalk entered the fruit and find remains of calyx: fruit is "superior"—that is, above the calyx or flower insertion. Where are the remnants of the calyx in an apple? At the opposite pole: fruit, therefore, below the flower, or "inferior." Take orange No. 1, and make an equatorial cut through the peel only, then strip this off neatly: source of orange colour now apparent—namely, in outer portion of the peel. Kindle the spirit-lamp, and squeeze the peel so as to expel the juice from the surface glands; this burns easily, like oil—call it orange oil. Squeeze some more, so as to taste it: bitter and acrid. Here, then, is the first line of defence for the seeds within—a tough, leathery skin with an unpleasant taste, to discourage would-be thieves; an oily secretion, to make it waterproof, and prevent escape of the sweet juice inside; and a thick layer of white felt for the same end. Before setting aside the peel, scrape off the white and show how to make "orange-peel" by soaking in hot sugar solution: observe to what a great extent the thin, yellow layer has swollen in the shop article, and also how it has become more transparent. Setting aside the two parts of peel to dry and help as fire-lighters, proceed to cut the orange also equatorially: observe how the white of the peel is continued inward, like spokes of a wheel converging on a central core of the same white felted substance, and enclosing the juicy flesh with the seeds. Count the sections, and ask the class to do the same with every orange they eat, answers to be ready for next lesson. It will be found that oranges present a surprising variety, any number of sections being obtained from 7 to 14, the favourite being 10 or 12. Lemons are more constant—generally 10, occasionally 8. Remove the seeds with a pencil, trying to see how they are fastened. Notice their peculiar shape and feel: very slippery, difficult to hold between finger and thumb; much more so in a bird's bill, a provision for dispersion which also operates even though a bird swallows them. Boil some seeds in a little

water, and observe how glutinous the water becomes. (*N.B.* In making marmalade, this operates in procuring a good jelly, so that it is a mistake to throw away the stones; they should be washed as above, and the washings added to the fruit juice.) Cut open a stone with a sharp knife to show the seed-coat (another protection) and the seed within, with its store of food for the embryo. As a matter of fact, there are several embryos; but one increases at the expense of the rest. Lastly, dispose of the other seeds by planting them in a common flower-pot, 7 to 8 inches across. An orange-tree is easily grown in a house, and makes a handsome ornament with its glossy leaves, bright orange-blossom, and even fruits, though these are generally dwarfed a bit.

Tease out the flesh from one section, and observe how it is held together by strands of fibrous tissue springing from the white peel near the outside. The teasing may be done very neatly by using a camel-hair pencil under a tap of running water, and proceeding gently.

Now take orange No. 2 and cut it in a great circle through the poles to get a vertical section, and see the structure of the liths or sections. Isolate a lith and see the skin on the outside, felted to the white peel. Wash out the pulp and stones, so as to see this skin alone. Now we have the three layers of the ovary represented—the peel, the skin covering each section, and the pulp representing the inner lining. Each lith is thus a single carpel; and in a young orange or lemon the carpels show by ridges even on the outer peel, though in a ripe orange they have all grown together, so that the peel appears uniform. Compare the lemon with these oranges as to shape, colour, sweetness, and acidity. Cut it across, and note the greater firmness of the white, with the consequent difficulty of separating the peel from the pulp, or the liths from each other. Similarly treat the Tangerine and the bitter or marmalade orange to fetch out the idea of varieties. Now examine the Jaffa orange: where are the seeds? Tell the story of the Jaffa orange, and explain how this seeming accident has led to a new variety of orange, which has to be multiplied, however, not by seeds, but by cuttings. As another example of artificial barrenness, ask for the seeds of a banana. Lastly, in the case of a girls' class, show the two leading methods of making marmalade. This may be done in a glass flask over a Bunsen or spirit lamp, and need not take more than five minutes' boiling. The best results will be reached at a temperature of 103–104° C. The orange thus presents the following points in fruit economy:—The peel is wrapped up in silk paper to prevent damage by friction: see the decay which follows when an apple is bruised, even though the skin is unbroken. It offers attractions to suitable parties by its colour, perfume, and stores of food, fruit-sugar, vegetable acids (citric), and jelly, and the colour is all the more striking when seen against the natural leaves of the plant. The seed is defended by the leathery peel with its oil-glands and disagreeable taste; the seeds are further protected from an animal eating the fruit by their shape and slipperiness, as well as by the seed-coat. The seed contains not only the embryo plant, but a store of starchy and oily food to nourish it. The whole orange has arisen from a superior ovary of many carpels, generally ten; and the three layers of ovary-wall are shown in the peel, the skin which covers the liths, and the pulpy flesh. If an orange-tree is available in a winter-garden, it should certainly be examined; for the orange may be seen in all stages at once on the same tree, from flower-bud up to ripe fruit.

For showing development of fruit from flowers, the apple, pea, and foxglove are recommended. The actual parts may be preserved in bottles containing two per cent. salt solution, to which not more than three per cent. of formalin has been added; but a preferable plan is to make clay models on an enlarged scale at each stage of the development. Since these will be wanted for future use, they may be made in plasticine, papier-maché, or in clay which has been mixed with glycerine instead of water to keep it constantly soft.

THE WORLD AND ITS PEOPLE.—A new volume of this series has just been issued on Australasia, and its well-written text and splendid illustrations fully support the claim of its predecessors that the series forms the most attractive and instructive geographical readers ever issued in this country.

HISTORY DAY BY DAY.

April.

1st. *County Councils* assumed their power, 1889.

2nd. *Death of Cobden, 1865.*—The great apostle of free trade was traveller for, and afterwards partner in, a Manchester cotton house. In 1838 he helped to found the Anti-Corn Law League, and devoted himself entirely to its advancement. He was a member of the Peace Society, and his attitude toward the Crimean War cost him his seat. He was afterwards returned for Rochdale.

Battle of Copenhagen, 1801.—Denmark and Sweden resented the severity with which Britain carried out her right to search neutral vessels, and this country had to face the probability of the fleets of Russia, Sweden, and Denmark acting in union with those of France and Spain. The British fleet appeared off Copenhagen, and after a desperate struggle silenced the Danish batteries, captured six ships, and shattered the proposed combination at a blow.

3rd. *Napoleon abdicated, 1814.*—The early part of 1814 saw the English, Russians, Prussians, and Austrians enter France. Napoleon made every endeavour to stem the torrent, but on March 30 the allies entered Paris. Four days later Napoleon abdicated, and was allowed to retire to Elba.

4th. *The Reading of the Declaration of Indulgence, 1688.*—Exerting his prerogative as Head of the Church, James the Second published the Declaration of Indulgence, suspending the penal laws against nonconformity, and dispensing with all religious tests. Disregarding all opposition, James ordered this declaration to be read during divine service on two successive Sundays. The clergy were practically unanimous in their refusal to obey the royal orders; in London the Declaration was read in but four churches.

5th. *Jellalabad, 1842.*—"I propose to hold this place on the part of the Government until I receive its orders to the contrary." Such was the declaration of General Sale when the terms of the Elphinstone treaty were communicated to him. The garrison bravely resisted all efforts of Akbar Khan to capture the town, and when it was known that General Pollock was marching to their relief, they made a bold sally and completely defeated the Afghan forces.

6th. *Capture of Badajos, 1812.*—After two futile attempts, Wellington succeeded in recapturing this town; but the siege and assault cost the assailants 5,000 men in killed and wounded. Terrible scenes were enacted in the sacking of the town, which lasted two days.

7th. *Wordsworth born, 1770.*—Born at Cockermouth in Cumberland, most of his life was spent in the Lake District. His chief poem is "The Excursion," a philosophical poem in blank verse. In 1843 Wordsworth succeeded Southey as poet-laureate.

8th. *Atbara, 1898.*—For fourteen years the Mahdi and his successor, the Khalifa, held sway in the Soudan; but steps were being taken to re-establish the power of the Khedive. A strong Egyptian army was formed by Sir Herbert Kitchener, the Sirdar, and at Atbara a severe defeat was inflicted on the Khalifa's forces.

9th. *Khyber Pass, 1842.*—General Pollock defeated the Afghans, and gallantly forced his passage through the terrible pass on his way to relieve General Sale in Jellalabad, but the latter had already defeated his besiegers (April 5).

Jamaica Bill, 1839.—In consequence of continued friction between the House of Assembly and the Home Government, Lord Melbourne proposed suspending the constitutions of the island for five years. Such a proposal from a Liberal Government naturally excited great opposition, and Melbourne resigned.

10th. *Toulouse, 1814.*—This closed the Peninsular campaign. Soult having been driven out of Bayonne fell back on Toulouse, where he took up a strong position and awaited the advance of Wellington. Neither commander was aware of the fact that Napoleon had already abdicated, or this sanguinary and indecisive battle would have been averted.

Chartist Demonstration, 1848.—Held on Kennington Common for the purpose of presenting a monster petition to Parliament. London was in a state of great alarm, as the wildest rumours were rife. The demonstration, however

proved a miserable failure, and was practically the death-blow of Chartism.

11th. *Treaty of Utrecht, 1713.*—This treaty, which concluded the War of the Spanish Succession, was most discreditable to the English Ministry. The principal object of the war, the exclusion of the Bourbons from the throne of Spain, was not secured, although it was stipulated that the French and Spanish crowns should not be united. Hudson Bay, Newfoundland, Nova Scotia, Gibraltar, and Minorca were ceded to England.

12th. *Rodney's Victory, 1782.*—Taking advantage of the struggle between England and America, France and Spain aimed a vigorous blow at England's naval supremacy, and for some time the French fleet under De Grasse conducted successful operations in the West Indies. These were, however, checked by Admiral Rodney, who on this day gained one of the most brilliant naval victories in the annals of history.

13th. *Magdala stormed, 1868.*—Theodore, King of Abyssinia, considering that he had a grievance against England, seized all British subjects within his reach. As he refused to liberate them, an expedition was sent out under Sir R. Napier, which stormed and completely destroyed the fortress of Magdala. Theodore died by his own hand when he found he could no longer hold the town.

Catholic Emancipation Bill passed, 1829.—In 1828 Daniel O'Connell, the founder of the Catholic Association, was elected as member for Clare. The Government met the difficulty by introducing an Emancipation Bill, which the Lords, who had rejected a similar measure in 1825, passed.

14th. *Battle of Barnet, 1471.*—Although Warwick, the king-maker, had compelled Edward the Fourth for a time to take refuge abroad, and had again placed Henry the Sixth upon the throne, his action in trying to force a marriage between his own daughter Anne and Henry's son had estranged many of the supporters of Lancaster. Edward landed at Ravenspur, and had marched to London before Warwick could collect sufficient followers to offer battle. When the two armies met at Barnet, a few miles to the north of London, the Lancastrians were defeated with great slaughter and Warwick slain.

15th. *Captain Porteous fired on the mob, 1736.*—A smuggler named Wilson was to be executed at Edinburgh. Much sympathy was felt for the prisoner on account of his generous action in enabling his fellow-prisoner to escape, and stones were thrown at the soldiers by the mob. Fearing an attempt would be made to rescue Wilson, Captain Porteous ordered his men to fire, and several persons were killed.

16th. *Culloden, 1746.*—Having advanced into England as far as Derby, the Young Pretender thought it prudent to retreat to Scotland. He attempted, but without success, to surprise Cumberland, who had been sent against him; and although the Highlanders threw themselves with reckless bravery on the ranks of the royal army, they were unable to break the lines. Cumberland showed such cruelty in the slaughter of the vanquished rebels that he gained the nickname of "The Butcher."

17th. *Franklin died, 1790.*—Born 1706; began life as a printer. He proved experimentally the identity of electricity with lightning, and suggested the lightning-conductor as a protection for buildings. For his scientific research he was elected member of the Royal Society. On the outbreak of the War of Independence he was sent on a mission to Paris to obtain the assistance of the French.

18th. *Relief of Chitral, 1895.*—After a laborious march from Cashmere, the town was captured, order restored, and a permanent garrison of occupation established.

19th. *Death of Beaconsfield, 1881.*—Born 1804; offered himself unsuccessfully as Radical candidate for High Wycombe, 1832; three years later stood for Taunton as a Tory, and again defeated; returned as member for Shrewsbury, 1837, and although he afterwards became a most brilliant speaker, his maiden speech was an absolute failure. In 1847 he became leader of the House of Commons, and afterwards Chancellor of the Exchequer. He succeeded Lord Derby as Premier, and again held office from 1874 to 1880. He was also the author of many brilliant novels.

20th. *The Rump dissolved, 1653.*—The army clamoured for a general election, but the Rump insisted on its members retaining their seats without re-election, and also claimed the right to determine the fitness of the new members. Cromwell settled the question by marching a company of musketeers down and clearing the House. "You mistake, sir, if you think the Parliament dissolved," said Bradshaw to Cromwell; "no power on earth can dissolve Parliament but itself."

21st. *Drake attacks Cadiz, 1587.*—With six of the queen's ships and twenty-four privateers, Drake entered the harbour of Cadiz and destroyed several ships and the greater part of the stores which had been collected for the Armada; in his own phrase, he "singed the Spanish king's beard."

22nd. *Odessa bombarded, 1854.*—This marks the opening of the struggle with Russia. In consequence of the Russian batteries firing on a flag of truce, the town was bombarded and partially destroyed.

23rd. *St. George's Day.*

Shakespeare born, 1564; died, 1616.

Warren Hastings acquitted, 1795.—To Warren Hastings was left the task of firmly securing the kingdom that Clive had conquered. This he did with great courage and ability; but the methods he employed were those of the East, and utterly repugnant to the Western mind, so that when Burke in impassioned language demanded his impeachment, he carried the whole country with him. The trial, which lasted seven years, ended in the acquittal of Hastings.

24th. *Russo-Turkish War commenced, 1877.*—In 1876 Servia and Montenegro attempted to free themselves from the Turkish yoke. The struggle was brief. Although the Montenegrin mountaineers held their own, the Servian peasants were butchered like sheep, and so enormous were the atrocities committed that Russia interfered. This led to a conference of the Powers at Constantinople, but nothing definite was decided, so Russia declared war.

25th. *Battle of Almanza, 1707.*—The success of Marlborough was outweighed by serious reverses to the allied forces in other parts. In Spain, the Duke of Berwick gained a brilliant victory over the allies at Almanza, which completely shattered all hopes of success in that direction.

Hedgeley Moor, 1464.—In spite of the terrible defeat at Towton (March 29), Margaret contrived to make another effort in the north; but the rising was crushed by the Earl of Warwick at Hedgeley Moor, and the queen escaped with her son across the border. The legend runs that during her wanderings Margaret was compelled to entrust her son to the care of a robber.

26th. *Warrant issued for the arrest of Wilkes, 1763.*—John Wilkes having freely criticised the king's speech in his paper, the celebrated No. 45 of the *North Briton*, Grenville issued a general warrant for the apprehension of its authors, printers, and publishers. This raised the point as to the legality of general warrants—that is, warrants that do not specify the names of the persons to be arrested—and Lord Chief-Justice Pratt decided against them.

27th. *Scots defeated at Dunbar, 1296.*—After acknowledging Edward the First as the Feudal Lord of Scotland, and receiving the crown at his hands, Baliol opened secret negotiations with France, and after a time refused to carry out his obligations to Edward. Although loath to strike the first blow, Edward showed no mercy when he found himself compelled to support his claims by force of arms. Baliol was completely defeated at Dunbar, and soon after surrendered.

28th. *Second Book of Common Prayer issued, 1552.*—The changes introduced into this issue of the prayer-book leaned toward the extreme doctrines of Calvin. Forty-two articles of religion were introduced which are practically identical with the thirty nine articles which formulate the doctrine of the Established Church at the present day.

29th. *Orleans relieved, 1429.*—Such was the terror inspired by the English that, although only 3,000 men-at-arms remained in the trenches before Orleans, no sally had been made for six months, and the city had been driven to make offers of surrender. The spell was, however, broken when Jeanne D'Arc appeared before the city. Encouraged by her presence and enthusiasm, the besieged garrison had no difficulty in repulsing the handful of besiegers, and in less than a week the siege was abandoned.

30th. *Fontenoy, 1745.*—Advancing to the relief of Tournay, the Duke of Cumberland found his way barred by a line of fortified villages and redoubts. Finding a gap near the village of Fontenoy, the English troops doggedly thrust themselves through, in spite of a terrible musketry fire; but when the day seemed won, the French artillery concentrated in front and tore the column to pieces.

OUR ILLUSTRATED GEOGRAPHICAL NOTEBOOK.

BRITISH SOMALILAND.

ALTHOUGH Somaliland has been known to history for many centuries, it never really came within the sphere of European influence until it was parcelled out between Great Britain, Italy, and Abyssinia some ten or twelve years ago. It is a country that is little known, and even now its geographical exploration is a matter of considerable difficulty.

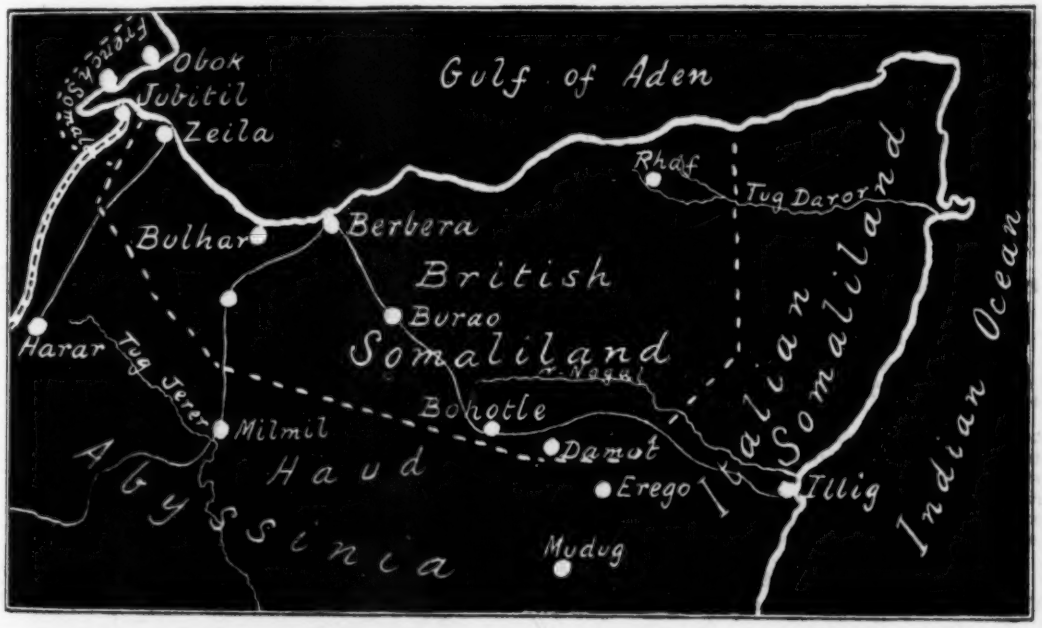
The Egyptians at one time endeavoured to annex the country, but were prevented by British intervention; and the Germans were also unable to obtain a permanent footing. The French possess a small strip near the Strait of Bab-el-Mandeb, the remaining portion of the northern coast belonging to Great Britain and Italy. Abyssinia claims all the southern region lying between British Somaliland and British East Africa.

As early as 1854 the British blockaded Berbera for a whole year, owing to an unprovoked attack on Captain Burton's expedition. The British demanded the abolition of slavery. This was conceded, but was largely evaded for a long time, the exportation of Somali girls to the south-east of Arabia being particularly brisk and lucrative. Great Britain secured the territory largely as part of a general policy to safeguard the overland route to India from menace by foreign powers.

The Country.—The British Somaliland Protectorate, which had its limits defined in 1894 and again in 1897, has an area of 68,000 square miles. The whole country may briefly be described as a table-land sloping from the Ethiopian highlands towards Cape Guardafui, the most easterly point of the continent. The rainfall is extremely scanty, and except in the immediate neighbourhood of the few rivers the surface is bare and arid, alternating with vast tracts of mimosa and aloe jungle. The country gets more parched from west to east, and in the region of the Nogal is almost a waterless desert. The east coast region—Italian Somaliland—is practically desert throughout, and scarcely a stream reaches the sea. Cape Guardafui is a vertical rocky headland rising 900 feet above its surf-beaten base. Though the water is very deep, shipwrecks are frequent, and the inhabitants of the region are experienced wreckers.

The climate of the British Protectorate is like that of South Arabia—marked by terrible heat and a lack of water. The prevailing flora consists largely of gum-yielding plants and aromatic growths, from which are produced the frankincense and myrrh of commerce. Coffee is indigenous, and may in the future prove a source of wealth. The animals include the elephant, lion, leopard, jackal, and hyena; there are herds of wild asses and several varieties of antelope; the ostrich is comparatively common. For many years to come the territory will provide sport for the big-game hunter.

People.—Somaliland has been styled the cradle of the human race. There are numerous tribes, each possessing marked characteristics that make any general description a matter of very great difficulty. Many of the people, notwithstanding their black skins, possess marked regularity of feature, probably the effect of intermixture with the natives of the neighbouring Arabian peninsula. The Mohammedan religion is general, and the natives are most particular in their observance of the Mussulman rites and ceremonies. Every village possesses its mosque, even though it be but a rude mud hovel, and from it the faithful are regularly called to their devotions. Alcoholic drinks are absolutely forbidden, except a fermented beverage obtained from camels' milk. Coffee is drunk but little, but the berry is ground up into a powder and eaten with butter. Tobacco smoking is almost unknown, but snuff is largely taken, and tobacco leaf mixed with ashes provides material for chewing. Tribal warfare has always been the bane of the Somalis. They take the life of each other with the greatest *sang-froid*, and the warrior gleefully adds another ostrich feather to his head-dress when he has compassed the death of an enemy. Slavery is now unknown among the northern tribes, but on the southern border slave-hunting is still common, and a great proportion of the inhabitants are in a state of servitude. The slaves are treated with marked cruelty, and usually wear shackles of great size and weight.



Recent Events.—The Mad Mullah, a religious fanatic, raised the standard of rebellion in Northern Somaliland and Abyssinia in 1901, which necessitated a joint expedition (British and Abyssinian) against him. Another expedition left Burao on May 12, 1902, and moved upon Damot, in the Haud region (stoneless land). The British force marched into the Nogal district (the stony land), but the Mullah retired in the direction of the Mudug oasis. Owing to the cowardice of the Somali levies, Colonel Swayne and his battalion of the King's African Rifles suffered a reverse at Erego, and had to retire to Bohotle to await reinforcements. A new expedition, consisting chiefly of an Indian contingent, left Berbera on 12th November, and relieved Bohotle. The natural difficulties of the country prevent rapid progress, but it is not anticipated that the dispersion of the Mullah's force will be much longer delayed, as the Italian Foreign Office has consented to allow the British to operate within Italian territory.

Trade.—The chief towns are the ports of Berbera (30,000), Zeila, and Bulhar. The imports in 1901 were valued at £393,000, and the exports £364,000; of the latter, cattle, skins, hides, ostrich feathers, ivory, and gums were the chief. The trade of the port of Zeila at least is now seriously threatened by the new railway from Jubitil to the neighbourhood of Harar, to which town a good transport road is being constructed to connect it with the line. It is proposed to carry the railway to Addis Abeba, the capital of the Negus. The line will enormously increase French influence in Abyssinia, and its effect on the trade of Western Somaliland cannot help being unfavourable to British interests. The traffic which now flows along the caravan routes to Zeila and Berbera, through Harar and Milmil respectively, will probably in future largely trend towards the railway, to the vast improvement in the trade of Jubitil.

PHYSICAL TRAINING.

A PROGRESSIVE COURSE FOR ELEMENTARY SCHOOLS.

BY H. RIPPON-SEYMOUR, A.C.,

Chief Instructor, George Watson's College, Edinburgh; Member International Congress of Physical Education, Paris, 1900; Author of "Physical Training," etc.

NOTE.—The military commands given throughout this course are almost exactly in accordance with the commands in the *Infantry Training; 1902*, and the *Model Course*, except where experience has shown a modification desirable. The alternative command will generally be shown in a footnote, and the teacher is at liberty to adopt either.

FIFTH LESSON.

Physical Exercises, Gymnastic and Figure Marching.

(The words of command are in heavy type.)

"**Hands on hips.**"—As before described (15).

55. "**Lunging to right and left, judging the time—Commence.**"—On the word "Commence," the class will lunge smartly to the right, as already described (24), make a short pause showing the correct position, then as smartly recover to the position of "Attention." A pause equal to that made on the lunge will be made here, when the "left lunge and recover" (25) will be performed.

This exercise may be repeated (say) four times to each side alternately, making in all sixteen movements.

56. "**Balancing, on the left foot—One.**"—Leaning slightly to the left, raise the right knee to the front nearly as high as the waist, the lower leg hanging vertically downward, the toe pointed towards the floor (Fig. 1).

"**Two.**"—Raise the right foot smartly as high as the knee, the right leg being now straight and as nearly horizontal as possible, the toe pointed to the front (Fig. 2).

"**Three.**"—Resume the first position, knee bent.

"**Four.**"—Resume the position of "Attention."

On the words "**Five,**" "**Six,**" "**Seven,**" and "**Eight,**" repeat these movements with the left leg. Repeat the whole

FIG. 1.

exercise three or four times with each leg alternately, the hands being placed on the hips during the exercise.

57. "**Lunging and reversing—One.**"—Lunge to the right, as before described, the shoulders and head turned to the right.

"**Two.**"—Keeping the feet apart, as in "Right lunge," raise the toes from the floor, and turn smartly to the "left about" on the heels, facing in exactly the opposite direction, and reversing the position of the feet and legs.

The pupil should now occupy the position of "Left lunge (25).

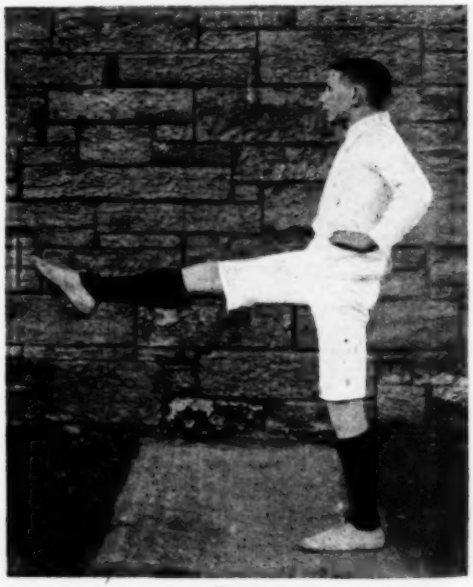


FIG. 2.

"**Three.**"—Raise the toes, and, turning to the right about, resume the first position—namely, "Right lunge."

"**Four.**"—Recover to the position of "Attention" by bringing the *right* foot back to the left (24).
"**Five.**"—Lunge to the left, as already described (25).
"**Six.**"—Turn to the right about.
"**Seven.**"—Return to the fifth position ("Left lunge").
"**Eight.**"—Recover to "Attention" by bringing back the *left* foot.

GYMNASTIC MARCHES (Nos. 2, 3, 4, AND 5).

"**Quick—March.**"—(12).

58. "**For gymnastic march, open—Out.**"—The rear files will step short until an interval of nearly one yard is obtained between the files, when they will resume the full pace.

No. 2.

59. "**High—Step.**"*—Give the word "High" whilst the right foot is on the floor, the word "Step" immediately following on the left foot. On the right foot descending, the left knee will be lifted to the front somewhat higher than shown in Fig. 1 (as high as the waist), the lower leg hanging vertically downwards from the knee, the toe pointed. Now, without pause, extend the left leg, and place the foot firmly on the floor, the heel meeting the floor first, and the

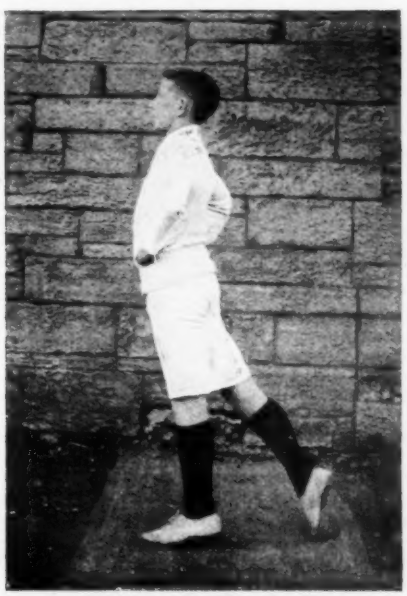


FIG. 3.

weight of the body carried well over the left foot. The right foot now executes the movement in a similar manner, the march being performed in *slow* time.

"**As you—Were.**"†—On the word "Were," which should be given whilst the right foot is on the floor, the left foot will be placed firmly on the ground, the hands dropped from the hips, and the ordinary "Quick March" resumed.

"**Double—March.**"—(38).

No. 3.

60. "**Knees—Up.**"—Raise the knees alternately a little higher than the horizontal line, the body and head erect. Check the length of the pace somewhat, but keep the correct cadence for "double" time.

"**As you—Were.**"—Resume the "Double March."

No. 4.

61. "**On the left foot—Hop.**"—Place the hands on the hips, carry the left foot to the front, and hop forward about twelve or fifteen inches, the right leg being kept well in rear and straight, the toe pointed downward, the head erect, the back hollowed (Fig. 3).

During the hopping the heels must not be allowed to touch the floor, and the pupils must be instructed to hop as high as possible each time.

62. "**Change—Feet.**"—Hop on the right foot in the position described for the left, substituting right for left, etc.

Hop about eight times on each foot, and then change.

"**As you—Were.**"*—Give this command whilst hopping on the right foot, when the pupils will beat the left foot on the floor, drop the hands, and break into the "Quick March."

No. 5.

63. "**Alternate hopping—Commence.**"†—Hop as before, commencing on the left foot, but changing feet at each hop, carrying the rear foot forward a full pace at the completion of each hop. The position during each hop should be the same as described in No. 61.

"**As you—Were.**"‡—Give this command at the end of a hop on the *right* foot, when the pupils will act as described before in No. 62.

FIGURE MARCHES (Nos. 1, 2, 3, AND 4).

"**In single rank, fall—In.**"—(1).
"**Number.**"—(5).
"**Right—Turn.**"—(9).
"**Quick—March.**"—(12).

No. 1.

64. "**No. 1, Parallel Lines.**"—(Fig. 4.) Place an intelligent pupil as leader, and instruct the class to follow him precisely in each evolution. The leader will march in a straight line across the room, and at a given point wheel left about and "counter march" in an opposite direction to the first line. After crossing the room in this direction, he will wheel to the right about, and form another parallel line, and so on as often as desired.

No. 2.

65. "**No. 2, The Crescent.**"—(Fig. 5.) This figure is formed in a similar manner to the first figure, but the class forms parallel curved lines, instead of parallel straight lines.

For good figure marching care must be taken that all the pupils follow the course set by the leader most faithfully, in order to produce the desired figure.

No. 3.

66. "**No. 3, The Maze.**"—(Fig. 6.) This figure consists of a series of concentric circles formed by the leader wheeling inwards time after time to his left or right, until he reaches the centre, following the course shown by the *heavy* line in the figure. He then reverses the movement by wheeling sharply to his right or left about, and marches outwards between the circles formed by the ingoing pupils, as shown by the *dotted* lines in the figure, until he reaches the point of entrance, when he may march straight on until the class unwinds itself, or he may continue wheeling in large circles

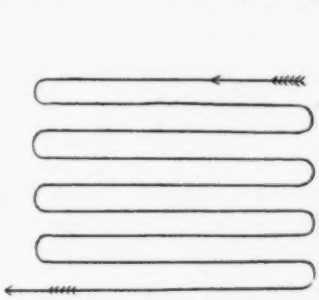


FIG. 4.

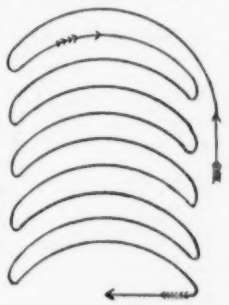


FIG. 5.

until the figure is unwound, and the last pupil having completed the figure, the leader recommences another "maze," as before described.

* "**In slow time—March.**"—*Model Course, 1902.*
† "**Break into quick time—Quick.**"—*Model Course, 1902.*
* "**Break into quick time—Quick.**"—*Model Course, 1902.*
† "**On the left foot—Hop.**"—*Model Course, 1902.*
‡ "**Break into quick time—Quick.**"—*Model Course, 1902.*

No. 4.

67. **"No. 4, The Figure of Eight."**—(Fig. 7.) In this figure the leader wheels to his left, forming three-quarters of a fairly large circle, and then makes across the room towards the opposite corner, crossing the line of pupils following him, who move forward in their own direction,

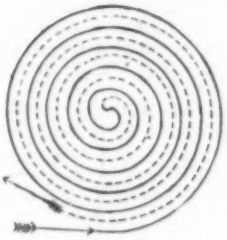


Fig. 6.

Fig. 7.

passing each other alternately, as shown by the *dotted* lines in the figure. After crossing the line, the leader wheels to his right, completing the second loop of the 8, and continues the figure again, and as often as desired. Care must be taken that the cross be made in the centre of the room, and that each pupil allows only one pupil to pass him before he crosses.

The author will be pleased to answer in these columns questions of general interest on drill and physical training. Letters should be addressed to the **Author, care of the Editor,** *and must enclose the coupon on back page of cover.*

THE INSPECTOR'S NOTEBOOK.

BY AN INSPECTOR OF SCHOOLS.

The Use of the Blackboard. In rural schools one does not find the blackboard used so much as in urban schools. Indeed, in quite a large percentage of all schools this *sine qua non* of the teacher's equipment is, to my mind, not called into service as often as it should be. I have recently visited half a dozen small schools, and in no case have I seen the blackboard in use further than for setting a copy.

Especially do I deplore the fact that infant teachers seem ignorant of the wonderful aid which the chalk gives to the enlivenment of the otherwise tedious round. Take arithmetic for example. It is resource that leads to success as a teacher. Is there any wonder that our little ones imbibe a distaste for figures when they are brought up on the eternal ball-frame, excellent piece of apparatus though that be when used in moderation? Variety is needed. In an arithmetic lesson of twenty-five minutes I would perhaps use the ball-frame, sticks, beans, and draw on the blackboard ponds containing fishes, and boxes full of oranges, bags of nuts, etc. Again, in the standards, and even in the infants, I would make the children come out and use the chalk. I would have blackboards all round my schoolroom and my classrooms. If a teacher had plenty of wall-blackboards he could allow his sketch-maps, drawings, copies for penmanship, music tests, etc., to remain as long as he found them useful. In American schools the blackboard is very much employed.

Mural Decoration of Schools. I have never drawn your attention to the question of the wall decoration of our schools. Publishers are doing their best to provide suitable pictures to adorn the walls. In many cases the productions are somewhat expensive, in others they are inartistic or flimsy. Maps look better than bare walls, but really they ought to be kept rolled up to preserve them from damage. Good pictures are much needed. The Art for Schools Association is doing good work in this direction, and I believe really excellent pictures can be bought from it at cost price, upon an assurance being given that they are to be hung in schools. It is very essential that children should have before their eyes works of art. They may not understand them, but they will nevertheless receive unconsciously good impressions from them. The cheap reproductions of the best pictures by the American Press, referred to before, are worth buying. Lessons should be given in explanation, and talks about the artists should take place. In many cases probably gentlemen interested in the school could be induced to present pictures. A plate could be attached indicating the name of the donor.

Pictorial Geography. In some schools the teachers prepare on brown paper with coloured chalks rough sketch-maps of the various countries the geography of which is to be taught. Care should be taken not to overcrowd these maps. The productions of the various parts can be shown by drawings. The children will remember much more easily the facts when presented in an interesting fashion like this.

The "Notebook" Query Column.

Letters intended for this column should be addressed "Inspector," care of Editor, Practical Teacher. Only in very urgent cases can replies be sent by post, and then only when two stamps accompany the letter.

Ignorant seeks advice *re* the Elementary Science for K. S. Examination—1. Need she take more than one branch? 2. Must she take two languages, and if so would English and Welsh do?

Answer.—1. You ought to take Section I. and one branch of Section II. Either A or B would suit you best, I expect.

2. You may take one language other than English. Yes, English and Welsh would do.

L. R. says he obtained a 2nd class in his first year certificate examination, and a 2nd in Part II., and a 3rd in Part I. of the second year's certificate. He is thus debarred from superintending pupil teachers. Is there any way of having this bar removed?

Answer.—See Art. 62 (*a*) and (*b*).

Yes, by re-examination. Pupil teachers may be recognised in a school in which the principal teacher is certificated, but is not entitled by examination to superintend pupil teachers, provided that (i.) the pupil teachers are taught in approved schools or central classes; and (ii.) the inspector reports that the principal teacher is sufficiently qualified on the ground of practical skill. You might approach the inspector and ask him whether he will approve of you under Art. 62 (*b*).

The sanction would be given in the Government report at the year-end if the inspector recommended it.

Anxious says that the Certificate syllabus for algebra includes quadratics, ratio, and proportion. He asks whether the theory of indices and surds is included, and suggests that it might be safer to study these.

Answer.—I am not quite certain, but should be inclined to regard indices and surds as being included. They will be dealt with in our Certificate Course.

Distress does not state clearly who she is. I presume she is an assistant mistress. Her trouble is that she has omitted to enter on her register the name of a child who has been admitted some time since. She appears to be agitated in mind about the result of her forgetfulness, and asks, "What would be likely to happen if the child's name should not be on the class register but be found on the admission register?"

Answer.—The best plan would be to confer at once with the head teacher, and enter the name at once on the class register. The head teacher could put an explanatory note in the Log Book.

Trahens inquires as to the qualifications needed to be able to teach drawing in Scotch elementary schools.

Answer.—Ignorance or want of expertness in drawing on the part of a teacher in charge of a school, who is under forty years, shall not, after a year's notice, be a reason for excusing the school from including drawing in the curriculum.

This is the only regulation I can find in the Scotch Code on the subject. It appears, therefore, that, as an assistant teacher, no definite qualifications are needed. I can hardly tell whether your certificates would be sufficient to qualify you as head-master should you be under forty, but I should think they would.

J. M. T. (Scotland) asks how a drawing certificate may be obtained.

Answer.—The conditions are a little confusing, and constantly changed. I advise you to consult Nelson's annotated edition of the current Scotch Code. You will find the matter clearly dealt with there.

St. Patrick.—I feel somewhat flattered by your kind allusion to my notes, and am glad you find them useful. Many thanks for so kindly forwarding me a specimen of the *Courtesy Reader.*

A SCHOOL NEWSPAPER.

ANY suggestion which helps to brighten school life, to lessen the monotonous routine of the teacher's occupation, will, no doubt, be gladly accepted by all those who are not entirely guided by what the Code lays down, but who give a thought to the happiness and welfare of the children among whom their lot may be cast, and for whom they live. To these I should like to point out one little way which I have tried for more than sixteen years, and with eminent success—namely, by introducing a school newspaper. My scheme has been carried out on a very modest plan, with absolutely no expense worth mentioning. The magazine with the special cover used in some large schools is replaced by one sheet of foolscap, divided into four columns, in which the items of news are written, on one side of the paper only. This, when filled up, is fastened on a notice-board, or some part of the school accessible to the boys during ordinary working hours and playtime. A title is required at first; mine is called *St. John's Hospital Reporter.* It is advisable to attach the name of your school to the title; but your older lads will be delighted at being taken into your confidence in this matter, and asked for suggestions. Then you will, of course, reserve a certain part for your own comments; whilst the remainder of the space might be utilised for recreative exercises, such as riddles, problems, etc., supplied by the scholars. I always require a whole sheet myself, there seems so much to write about, and I begin early in the week by commenting on whatever in my opinion should be noted. Some articles are of regular occurrence—for example, my attendance table, which is set down so as to place the classes in order of precedence. It is cheering to notice how keenly the different standards watch to see who comes on top. As Monday morning comes round for the new issue to appear, there is quite a rush to the reading stand to see who heads the list.

Supposing you have a cricket club in the summer, or a football club in the winter, reports of matches are gladly received, and many a boy's interest can be secured by giving him public notice for some skilful bit of play. Frequent opportunities offer themselves to a judicious teacher of offering friendly advice to the lad who throws the utmost energy into his games, but fails to give satisfaction in his school exercises.

Results of competitions and of scholarship examinations are suitable subjects to enter. There is almost certain to be an amateur photographer in the school, who would only be too pleased to have specimens of his work attached to the paper. References to old boys who have succeeded in life, who keep up a correspondence with their old masters, always give satisfaction. Visits of old boys, governors, ladies and gentlemen interested in the work of education, can easily be commented on. Every month the results of class examinations can be posted up for general observation, and in connection with this should be congratulations to deserving lads from the head-master.

Should any of my colleagues adopt this idea, I feel sure he will be amply rewarded for the little labour incurred, and will never regret the experiment.

CIRCULAR FROM THE BOARD OF EDUCATION.

THE President of the Board of Education has appointed Mr. H. M. Lindsell, who has for several years been Advising Counsel and Assistant Secretary to the Board, to be Principal Assistant Secretary in charge of that branch of the Board which deals with Elementary Education. The appointment is consequent upon the retirement of Mr. John White, C.B., in April next.

The passing of the Education Act, 1902, renders it necessary to make various changes in the organisation of the Inspectorate of the Board. It is intended, so far as circumstances render it possible, to place the Inspectors of the Board in such relations with the new Authorities as to obviate any unnecessary duplication of inspection, and in particular to place directly at the disposal of the Local Authorities the reports and suggestions of the Board's Inspectors as to the working of the schools in their districts. In order to facilitate these arrangements, the Inspectors' districts are being re-arranged so as to coincide, as far as possible, with the areas of the new Local Education Authorities. On the retirement of Mr. T. King, H.M. Senior Chief Inspector of Schools, on April 4 next, after thirty-two years' service, the President has appointed Mr. Cyril Jackson (formerly a member of the London School Board, and since 1896 Inspector General of Schools to the Government of Western Australia) as Chief Inspector of the Board for Elementary Education, to carry out the changes above referred to, and to be, under the Secretaries of the Board, the responsible Head of the Elementary School Inspectorate.

The officers of the Elementary Branch of the Board, hitherto known as Chief Inspectors, will become Divisional Inspectors, and will be responsible to the new Chief Inspector for the work of the various Inspectors in the districts within their respective divisions.

The President has promoted Mr. H. M. Richards (Junior Inspector), and Mr. G. H. Grindrod (Sub-Inspector), to be Inspectors of the Board.

A small temporary committee of investigation into the education and training of urban and rural pupil teachers has been appointed. It will consist of Mr. Legard, Chief Inspector of Schools in Wales; Mr. Buckmaster, a Chief Inspector in the Secondary Branch of the Board; Mr. Airy, Inspector of Schools in the Birmingham District; Mr. R. F. Curry, Inspector of Schools in the Somerset and Wiltshire District; with Mr. Grindrod as Secretary and Organising Inspector (not attached to any particular district). Miss Hale, Principal of the Edge Hill Training College, Liverpool, will also assist in the investigation.

The duties of the committee will be—(*a*) To inspect the different methods that have been adopted in recent years, especially since the Report of the Departmental Committee in 1898, in certain urban and rural districts for organising the training and instruction of pupil teachers;

(*b*) To consider with the Inspectors in each district, and to suggest to the new Local Authorities various means of initiating or improving such methods; and

(*c*) To advise the Board of Education as to the changes that may best be made in the existing regulations of the Board, and possibly in the arrangements of grants, in order to facilitate the improvement and co-ordination of this part of the educational system of the country.

The establishment by the Education Act, 1902, of Local Education Authorities, responsible at the same time for the efficiency of the teaching staff of the Elementary Schools and for making provision for Secondary Education, will make it possible to look for a considerable improvement in the instruction and training of pupil teachers; and it is hoped, through the appointment of the committee, to bring about as soon as possible a judicious dissemination of information as to the best methods in use, and the means by which these can be improved and extended.

EASTER is a specially suitable time for paying a short visit to the Continent, and those of our readers who wish for a delightful change cannot do better than spend the holiday in the charming old towns of Belgium. The Belgian State Railway will issue cheap return tickets, available for eight days, and allowing the traveller to break his journey at Ostend, Bruges, Ghent, and Brussels. The third-class fare is covered by a pound, and the first and second is only a little more. Tickets and further particulars may be obtained at the company's office, 53 Gracechurch Street, E.C.

The Practical Infant-School Teacher.

OUR MODEL INFANTS' SCHOOLS.

XIV.

LEAVING for once the ordinary school in town or village, we turn to one that is particularly fortunate in its management, its equipments, its staff, and its children. We wish heartily that all schools were as happy in their environment as this.

The patron of the school is the owner of a large and prosperous iron foundry and coal-field. If he were a less busy man than he is in the affairs of life with which a gentleman in his position has to deal, he would probably manage the school himself, for he is exceedingly interested in the welfare and progress of the children of his work-people. He often visits the school, and in many ways keeps in touch with its work. The management, however, he has entrusted to a committee of twelve, three of whom are ladies, and all connected in some way or other with the estate. The steward is the chairman; the iron-workers send two representatives, and the miners three. As to equipment, the mistress proudly boasts that she gets everything she asks for, and the school abounds in the newest and best apparatus. The children number three hundred or thereabouts, and the average attendance for the year just closed was two hundred and ninety-one. In addition to the head-mistress, the staff consists of six certificated assistants and three pupil teachers. The classes average about fifty children each, and there are two separate standard classes, both mixed, an upper and a lower, arranged according to merit.

In such a school the work must proceed smoothly, and the teachers are able to attack subjects and make progress in them that are beyond the reach of less fortunate schools. The mistress is a Cheltenham-trained lady, and she possesses all the activity of body and mind that any teacher could desire. She has a large, sympathetic heart, in which she nourishes a strong attachment for the little folk under her charge. She is the wife of the master of the mixed school, and this is the tenth year of work.

What strikes one first of all on entering the school is the quiet "hushness," that is felt. There are three classes working side by side in the large room, amid almost perfect silence; and it is wonderful to see how little notice the children of one class take of another when they are at lessons.

We cannot enter into the whole of the work of the school, but must content ourselves with one or two features of a specially interesting nature. The plan of teaching the elementary subjects can be gathered from a study of the page of the "progress" book which we print.

The correlation of subjects should be noticed. Transcription, dictation, number, conversation, clay modelling, and brushwork are all based, when possible, on the object lesson. For example, on the morning of the visit the standard children were at arithmetic. The object lesson for the week was "a lemon," and the children were working these sums:—

1. From a basket containing forty-one lemons twenty-nine were taken. How many remained?

2. If the lemons which remained were divided equally between three boys and three girls, how many each would they have?

3. Two men had each a basket of lemons. They counted them. One of them had four more than the other, and the one who had least had twenty-nine. How many had the other?

4. Put the following lemons into one basket, and tell me how many there are: 36, 27, and nineteen.

The sums were told to the children in story fashion; and when the story had been grasped, the sum was put on paper, checked, and then written on the blackboard. When all had been finished and marked, those on the blackboard were worked; and as the teacher knew where mistakes had been made, special attention was paid to these places. Papers were afterwards redistributed, and corrections made. As a test in spelling, the following was dictated:—

Lemons are very like oranges. They grow on trees, and are pretty to look at.

On the morning previous to the visit, a lemon had been modelled in clay. Only one specimen had been kept. It was small, but of a very good shape. The indentations had been put in with the sharpened point of a lead pencil. In a similar way, the copy on the blackboard (made in chalks, yellow and green) showed that a lemon had been the subject of a brushwork lesson.

A word or two as regards the keeping of the clay may be in place. The clay is stored in a wooden box with a lining of zinc. After every lesson the clay is pulled to pieces by a pupil teacher, and covered over by a damp cloth. The clay absorbs the moisture, and is thus ready for use when wanted again. The modelling boards are made of hard wood (American birch), and seemed to be exceedingly suitable for the purpose.

Drawing.

The drawing scheme is a very comprehensive one, and is drawn out on similar lines to those adopted in schools for older children. We print the scheme in full:—

Babies.—Drawing in sand for the first six months of the year, afterwards on paper. Combinations of straight lines and simple bends. Easy printed letters—for example, A, F, D, H.

Class I. (ages 4).—Drawing of straight lines and simple bends on half-inch dotted paper. Original patterns to be encouraged. Brushwork: the blob to be drawn in first four positions, and easy patterns made therefrom.

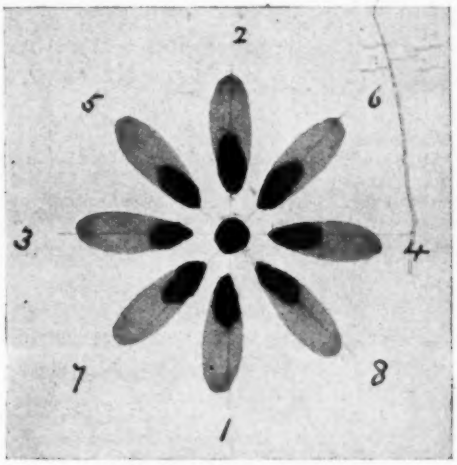
Class II. (ages 5).—Same as in Class I., but on three-quarter inch dotted paper. Longer lines are expected, and the bends may now be called curves. Brushwork: the blob in eight positions, and easy patterns made therefrom.

Class III. (ages 6).—Straight lines and curves on one-inch dotted paper. Patterns from copy, and original work encouraged. Leaf forms from object in season. Brushwork: easy flower and leaf forms, dots, circles, curved and straight lines of even thickness.

Standard:—Combinations of straight lines and curves on one-inch dotted paper. Ruler drawing of square, oblong, and easy patterns; measurements to be in inches. Patterns from copy and original. Original drawing to extend to illustrations of easy and suitable stories. Brushwork: flower and leaf forms, and, when possible, to be based on object lessons.

Imaginative Drawing.

It will be seen from the drawing scheme that the mistress believes most strongly in cultivating the children's imagination, and there are many evidences in the school of the

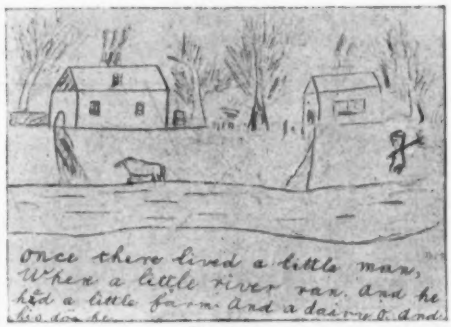


EIGHT POSITIONS OF BLOBS.

children's work in this direction. Carefully kept in a drawer of the desk is a large home-made picture album, which contains contributions drawn by the children from time to time. The drawings are all illustrative of some lesson which has been given, or poetry learned, or reading either by the teacher or the child. No one would call them beautiful or well executed, but they are exactly what the children think, and this fact makes them valuable. The teacher is enabled to see what correction has to be made in the children's mind, and what particular feature is wrong in the drawing. The writer had the opportunity of seeing a whole class "go through the mill," and was very much surprised at the result. When paper and pencils had been distributed, and everything was ready, the teacher announced that she was going to read a story of a farmer who lived in a farmhouse near a river. A great many things happened to him, and the children were told to think of them, and draw just what they thought would be a picture of the farmer. Then they closed their eyes and listened to that old story in rhyme which tells of disasters that happened to the hero of the story. When the reading was in progress drew a *word picture* of the little man and his farm. She described him as being in one of his fields near the house, perhaps going to work, and perhaps returning home tired and wanting his tea. She told them to remember the little river which, perhaps, he would have to cross. The children were reminded of the way in which rivers ran, not in straight lines, but wandering about now in one direction, now in another. She pointed out, too, how the farmer would have to cross the stream, perhaps by a bridge if the river were wide, and by a plank if that were sufficient. The little dog must not be forgotten, for he was a faithful little creature, and followed his master wherever he went. Several farm implements were mentioned, and it was suggested that perhaps the farmer would carry a scythe, or a hay-rake, or a basket. Questions were asked on these. If a scythe or a rake, the mowing season was elicited; if a basket, it might contain eggs which the farmer was bringing to the house, or in which perhaps he had carried his lunch to the field. The children, indeed, went through the whole story, showing that they had remembered it very well. Then the first verse of the story was written on the blackboard in a nice clear hand. The children read it simultaneously, and then were told to draw a picture of the farmer, the farmhouse, the river, and the faithful little dog, and write under the picture the verse from the blackboard. Some of the quicker children commenced immediately, but many of them spent some time considering what they should draw. It is pleasing to note that every child attempted something. Through the kindness of the head-mistress, we are enabled to produce specimens of a few of the drawings. During the drawing no child was prompted or interfered with. When a boy asked if he might draw the dog running after a rabbit (which, after all, was a very sensible thing to ask, considering the dog was supposed to be in a field), he was told to remember that the doggie's name was *Fidelle*. It is significant to note that this boy's picture of the dog, marked No. 1, is more like a lamb than a dog. He *did* remember Fidelle, and no mistake. But, said the teacher, "What are these?" pointing to the buttons on the farmer's legs. "Please, teacher, they are his leggings, and those are the buttons." Then he was told to look at them carefully and find out something that was wrong—something that *must* be wrong. He looked for a considerable time, but was not able to find a mistake. He counted the number of buttons. They must be right, for there were two on each. What could it be? Another boy was called to his assistance. No, he could not tell. Then the second boy was told to stand in front of the class, where he could be seen by all the children. The first boy was told to look at the boy's legs as he stood in front and imagine he was wearing gaiters. The teacher then turned him round, putting him in a side position. "Now,"

Once there lived a little man
Where a little river ran
And he had a little farm and
a little Dairy O. And his
dog he called Fidelle.

No. 1.



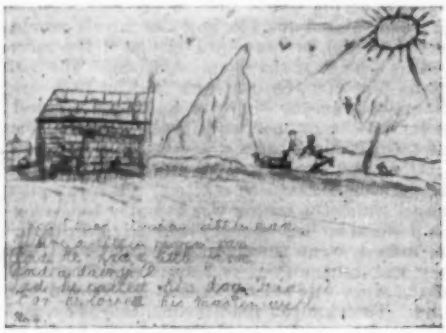
No. 2.

No. 3.

the children listened very attentively, and smiled over and over again. Sometimes they laughed boisterously, and rolled about in their little desks. No matter, the teacher knew they were understanding it, and felt sure she should get something for her album. The reading over, the teacher drew them to attention, with eyes fixed on her, while she said she, "if Harry were wearing gaiters, on which leg would you see the buttons? or would you see them on both legs?" The boy confessed that he would only be able to see the buttons on the nearest leg. "Very well," said the teacher, "look at your drawing." A smile showed that the boy saw the mistake he had made, and in the future there is no

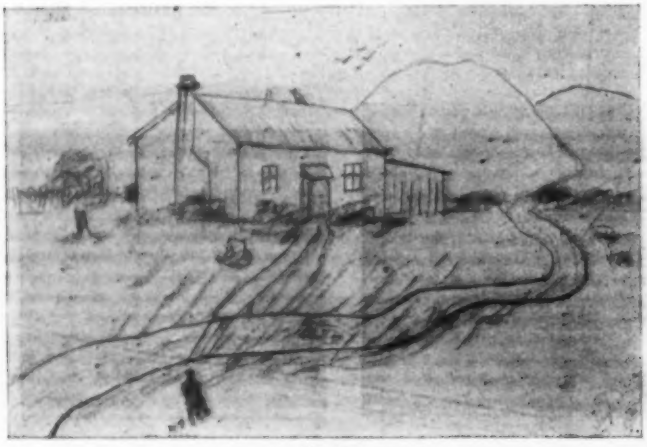
doubt his observation will be all the keener for it. The flowers he had drawn, he said, were daisies.

In looking through the whole of the drawings, it is nice to notice how differently the same things appeal to different children. The careful and painstaking teacher gets many



No. 4.

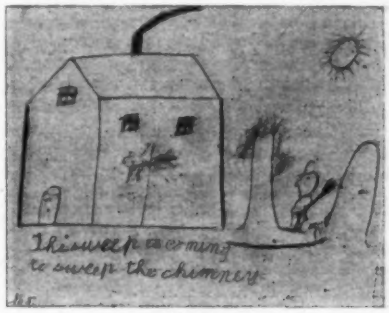
hints from them which will help her in her descriptive lessons. In No. 2 the child has drawn water running from the roof of the dwelling into the water-butt. He must have seen something of the kind when visiting the country, and he evidently knows the value of rain-water. The owner of No. 3 seems able to draw trees better than anything else, though he has a fair notion of house drawing. He has tried, in fact, to show the door partly open, and has not forgotten the plough. The boy who drew No. 4 is a very thoughtful and careful little fellow. The house is supposed to be built near a road, and over the hedge are to be seen the farmer and his dog following a cart. The hedge, of course, hides the wheels of the cart and the legs of the man, and for this piece of reasoning the boy certainly deserves much praise. He has benefited by some previous lesson—possibly a conversational lesson—for he has shown with considerable skill a hill in the distance. The farmer's heart should rejoice at the brilliancy of the sun. Every separate picture shows something original, and we are sorry not to be able to reproduce more of them. We should like to show the full farmyard of one, with its tall farmer followed by his faithful hound, which is nearly as tall as himself, and which would certainly weigh many more stones on the scale. On another is to be seen a lazy cow rubbing herself against a hayrick;



No. 6.

while another through the open window of the house tells a sad tale, for a pint bottle and a common earthenware mug are clearly shown.

The writer expressed his surprise at the general excellence of the drawings, especially as they were done so readily. He was assured that such results were not to be obtained in a short time, but that they were the outcome of considerable practice and regular teaching. The example shown as No. 5 was done by the same boy who did No. 1. It shows a year's progress, for No. 5 was done exactly a year ago. Wishing for his own experience to find out how this kind of work



No. 5.

would be done by older children, the writer told the same story on the following morning to several boys whom he selected from his own Standard VII., and asked them to draw him the illustration. No. 6 is the result. The boy whose work it is does not learn landscape drawing at school, nor has he before had experience in imaginative drawing. What a pity it is that the splendid ideas of infant school mistresses should not be carried out in schools for older children!

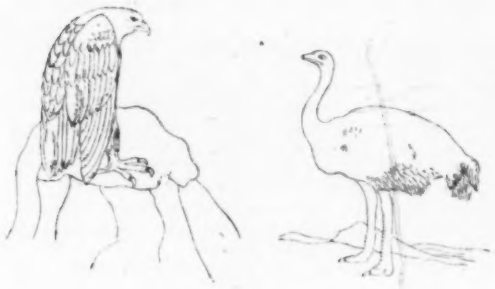
Picture Reading.

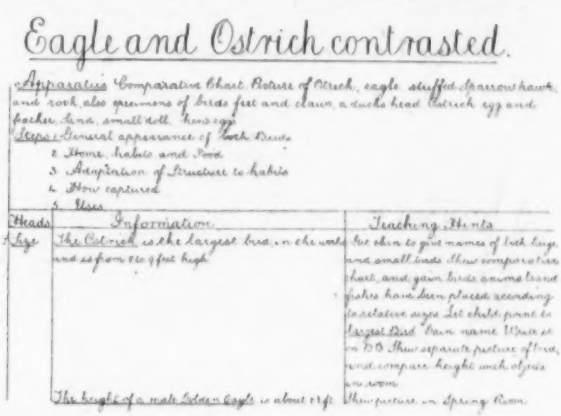
Intensely interesting as was the imaginative drawing, still another surprise was in store. This was a lesson in picture reading. An ordinary wall picture was placed on an easel in front of a class, and the children were told to examine it very carefully, and be ready in a few minutes to *read* it. It was a picture of an old man, a gardener, evidently on his way home from work. He had been met along the road by a little girl who was probably his granddaughter. He had lifted her into a wheelbarrow which he was leisurely pushing along, and the smiles of the old man and the little girl betokened the pleasure both were deriving from what was going on. They were nearing a cottage where roses were growing over the wall and round the windows, and there were several articles, such as a stool, a broom, and a washing-tub, lying about near the door. The way in which the picture was dealt with by the children one after the other was very remarkable. They *read* it just as if it were a real story in a book, and hardly a point was overlooked. What one child missed, another supplied. To test the children still further, and so as to assure the writer that the same picture had not been used for picture reading before, a book was borrowed from the girls' school attached. A picture was chosen from it and given to a little girl of six. Her reading was taken down in shorthand—a simple task, for she read very slowly. It was as follows:—

"The picture shows us a nice green field, with a stream running along under a big hedge. Some boys are playing in the field. I think they are playing at a very cruel game. One of them, who is the biggest, he has got a white cat in his hand, holding him up. I expect he is going to throw him in the water. The boys who are playing are some looking very sorry, and some are very glad. One of the boys is running to the one who has the cat in his hand to take it off him. The boys are all nicely dressed, and they seem to be very well off."

When a mistake was made in the reading—for example, when the little girl said, "One of them, who is the biggest, he has got, etc."—she was told to stop and say what a book would say if the story were printed. If she could not do this herself (and it is a very difficult thing in oral composi

tion lessons to make a child alter the first form of sentence used), the class was asked to suggest a better reading. A good point in this exercise was that the girl was not stopped in her reading the moment the teacher saw she was going wrong, but when she had completed the sentence. Several children were asked to read the same picture, but they evidently remembered what the leader had said, for very few of them made any noticeable alterations. The exercise, however, seemed to be productive of very intelligent work, and it is mentioned not merely as a novelty, but with the hope that some of the readers of our INFANT SCHOOL section will experiment on some such lines. A grain of original (if it be intelligent) work is worth a bushel of cram.




Eagle and Ostrich contrasted.

Apparatus Comparative Chart. Picture of Ostrich, eagle stuffed Sparrow hawk and rook also specimens of birds feet and claws, a duck's head Ostrich egg and feather, hens, small doll, hens egg

Steps: 1 General appearance of both Birds
2 Home, habits and food
3 Adaptation of structure to habits
4 How captured
5 Uses

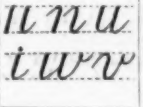
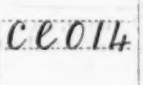
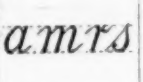
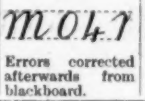
Heads	Information	Teaching Hints
1 Eyes	The Ostrich is the largest bird in the world, he stands 8 to 9 feet high	Be shown to give names of both Eyes and small birds show comparative chart and gain birds & animals heard & skins have been placed according to stature says Let chalk point to largest Bird Pupil name Where is an O.S. Show separate picture of bird, and compare height with objects in room
	The height of a male Golden Eagle is about 4 ft.	Show picture in Spring Room

NOTES OF LESSONS (FROM TEACHER'S BOOK).

Mutual Help.

The teachers are a very enthusiastic set, and they evidently take a great interest in whatever goes on in any class. This must be very helpful to the work of the school as a whole. While the little girl was reading from the picture, an incident occurred which bears this out. A number of children came filing into the room from another class. Each of them carried a slate showing, as they walked, an exercise in transcription. They had come to the teacher of this class so that she might assist in selecting the best piece of work. The writing was very even and very good, and it was a difficult matter to prefer one to another. Each child was commended for the excellence of the work; and when they were told that the one which was best was not much better than the others, they all seemed pleased and satisfied with the adjudication. Before they went away the teacher allowed her own children to look at "the beautiful writing." They examined it with keen delight, and it was evident, from the recognitions that were made, that brothers and sisters were taking pleasure from the work of junior members of their

An Open Page of a Progress Book.

DAY.	READING AND WORD BUILDING.	WRITING AND DICTATION.	NUMBER AND FIGURES.	OBJECT AND CONVERSATION.	KINDERGARTEN AND OCCUPATION.	RECITATION AND SINGING.	PHYSICAL EXERCISES, ETC.	RELIGIOUS INSTRUCTION.
MONDAY.	Word building—Sound of *e* preceding consonants, *en*, *eb*, *et*. Three-letter words from *en*—for example, end.	Figures 0, 1, 4, 5 from blackboard, and then from dictation.	Revision of 1, 2, 3. Addition, subtraction, multiplication, and division.	Object—Apple. 1. What it is. 2. Whence obtained. 3. Chat on orchard.	Paper folding	"Five years old" as a class together, and individually.		Repetition of Psalm xxiii.
TUESDAY.	Reading—Page 12, par. 1. Words built and read. Sentences read together.		Number from set of ninepins. Picture 4. Addition, subtraction, and multiplication.			"The chickens." Modulator. Revision of last week's song.	Free drawing of leaf from copy.	Old Testament—Creation, third day.
WEDNESDAY.	Reading—Page 12, pars. 1, 2, and 3, class and individually.		Children called to blackboard, and examined one by one on picture 4.	Object—Apple. 1. Size. 2. Colour. 3. Shape, dents, etc.	Brushwork from dictation—that is, load brush, unload, place, raise, repeat. Children taught to wash their apparatus.		Free drawing. Repeat drawing, and inverted	Hymn.
THURSDAY.	Reading—Page 13. Words at head of lesson and in par. 1 built and read.	Trans. 	Number with set of ninepins. Picture 5.		Clay modelling—Apple. Observation of broken surface of apple. Care with eye and stalk-end.	Repeated last verse of "The Chickens," to correct error of expression.	Physical exercises—Hoops for the first time. Children taught how (1) to take hoop, and (2) to hold it. Exercises 1 and 2 taught.	New Testament—First part of story of Christ feeding the five thousand.
FRIDAY.	Reading—Page 13, pars. 1, 2, and 3. Individual building of words.	Dictation.  Errors corrected afterwards from blackboard.	Figures from blackboard. Special attention to figures 3, 5, 9.			Revision of songs.	Dance—Pas de Quatre. Forearm exercise, No. 12 (piano).	Moral Story—Not to waste food, and to say grace before meals, from Christ feeding the five thousand.

family. The little ones blushed and smiled without being bashful or timid. The way in which the staff joined together when lessons for the morning were over, and chatted and laughed at the results of the imaginative drawing lesson, was further evidence of the mutual good feeling that existed between them. They all made appreciative comments, and the writer was very much impressed with the help one derived from the remarks of another. At the request of the mistress they showed their notes of lessons, and the way in which they kept their daily records of work attempted. These sets of books were in every case very carefully and methodically planned. Accompanying the notes of lessons were drawings (when possible) of what would be drawn on the blackboard at the time the lesson was given. Real objects were particularised in red ink, and from the frequent use of that liquid it could be seen they were often used. In some infant schools elaborate drawings are made ready for use in object lessons, and, when possible, left on the blackboards for purposes of revision of the lessons. In this school this plan does not seem to find favour. There were a few coloured drawings on black prepared canvas, but except what had been done on this particular morning the boards were clear of illustrations. It was learned in conversation that the favourite way of illustrating a lesson was by roughly sketching as the lesson proceeded. There is no doubt that each of these methods has its own advantage. Where a teacher can sketch rapidly and accurately, perhaps the latter method is the more valuable. The pupil teachers here practise at least one sketch a week under the guidance of the teacher whom they assist, and this whether the sketch is to be used or not. In this way they derive an amount of skill which must in their future career be very useful and profitable to them. It is amazing to see how poor their first attempts are, and how fast their progress is when once they have made a start. Possibly the drawings of the children (one does not seem able to leave this feature of the school) encourage the young teachers in this direction. An open page of one of the daily "progress" books is given on the preceding page. It shows a completed week's work. It is written at home at the end of each week, but during the week rough memoranda of the lessons are kept. It must be understood, of course, that the lessons are prepared for each day overnight.

SOME USEFUL BOOKS.

A REVIEW.

WE have received from three enterprising publishers of school books four publications which are of intense interest to teachers of infant children, and to which we feel we ought to draw their particular attention. These are our reasons for inserting a special notice of them in the INFANT-SCHOOL section.

1. *Free-Cutting: A Kindergarten Occupation.* By Mrs. Hannah Dean. (E. J. Arnold and Son, Leeds.)—Of the many schemes that have been devised to meet the requirements of Appendix Nos. VIII., IX., and X. of the Code, this must certainly be ranked as one of the best. It is an "occupation," and the authoress sends it forth, after proving its merits in her own school, with the complete assurance in her own mind that it will prove of value not only as a help to manual training, but also as an interesting subject which will develop and educate the mind in many directions. We cordially concur in this opinion. Take away all the crutches you can from the teaching of infants, and the better they are prepared for the upper schools. This "occupation" is without a crutch. Correlate as much as possible, and there will be no break in the instruction. There may be under some conditions wearisome reiteration, but in this book there is no weariness. It is aptly named and sub-titled. The exercises are graded splendidly, and are connected with lessons in composition, spelling, observation, and form. An important feature is that the work it entails encourages originality and intelligence. The materials necessary are perhaps rather numerous, but as they may also be used in other lessons (for example, brushwork), this need not prevent *free-cutting* from being adopted. What are wanted can be supplied at a reasonable figure by the publishers of the book, an advantage that cannot be over-estimated. The exercises are cut in coloured paper from copies drawn on the blackboard by the teacher; and as the paper is gummed on the back, each piece of work can be affixed, either in an exercise book kept for the purpose, or on a sheet of cardboard. We can imagine the pleasure of the parents and older brothers and sisters as they turn over the pages of the books and can realise the usefulness of the specimens on cardboard for school decoration purposes. At first the "cut-outs" are in a purely geometrical form; afterwards they assume shapes of common objects and floral forms. Some of these last are charming, and must be delightful to the little children who watch their growth from the paper. The price of the book is 1s. 6d. net.

2. *Leaves for Infant Teachers.* (Waddington and Jackman. Price 2s. 6d.)—This book contains a large variety of work suitable for introduction in infants' schools. The drawing section is by Mr. Alfred Wilkinson, and it is entirely a coincidence that our article on MODEL SCHOOLS this month contains specimens of work very similar to that here advocated and described. Imaginative drawing is of a kind that is fast coming to the front in this country, after having been practised for many years in America; and as it is an exercise in which the inventive faculties of the children are called upon, it must be a highly desirable form of work. Every teacher devoted to *child study* agrees with its principles. The illustrations in this section are interesting and educative. "Arithmetic for Infants" is the title of an excellent scheme of work. It is, in fact, the scheme which was sent by the London School Board to the English Education Exhibition a few years ago. It was there very much admired, and we cordially commend it to the notice of the readers of this section of the *Practical Teacher*. Miss Bessie Crossland, of the "Paragon" Schools, is the authoress. "Kindergarten Gifts" are dealt with in an able manner by Miss Annie E. Jackman, and the way in which the subjects are treated will well repay a careful perusal of them. Miss Margaret Cameron, L.L.A., is responsible for several sections of the book, and in each her well-known sympathies for little folk are evident. She was a cultured mistress, and we are glad that, though she has left the profession, she has not laid down her pen and brush in their interests. After dealing with several other important branches of infant children's work, the book concludes with seventeen pages of blackboard drawings; those by Miss S. A. Dews, showing contrasts from the animal world, are exceptionally clear and educative.

3. *Reading made Easy.* Part I. By Anna Snell. (George Philip and Son, Limited. 8d.)—Miss Snell is an advocate of teaching speaking, drawing, writing, and reading in combination with each other; and the fact that she has been called upon for a new issue of her book in the course of a few months shows that her plan has many admirers. The book contains twenty-one pages of reading matter, and each page shows a complete lesson. The grading has been carefully and systematically done, and in every way the book is a desirable friend to teachers of infant children.

4. *Games, Songs, and Recitations.* Edited by Alfonzo Gardiner. (E. J. Arnold and Son, Leeds.)—We have here a large and splendidly varied selection of verses suitable either for singing or recitation. Most of them are new, and have been specially written for the work. The music is in every case in sympathy with the words, bright and catchy and tuneful, and although there are one or two hard notes to sing, the accompaniment is so helpful that little difficulty ought to be experienced in teaching. Both for school and concert purposes the book is a treasure. To the verses appointed for recitation suggestive actions are given. These are suitable and effective. The authors of the several pieces are well known as writers for little children, and the editor is to be congratulated on the production of so valuable an aid in an infants' school. The price of the book is 2s. 6d. net.

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Principal of the Belvedere Pupil Teachers' Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

NEW SCHOLARSHIP COURSE FOR 1903.

Fourth Month—April.

(*N.B.*—**I should be glad if students who intend to follow this course regularly would send their names and addresses to me.**)

Work for the Month.

1. *Reading.*—Remember that oral practice must be regularly taken. For special preparation, *The Heroes*, Story iii. : Theseus.

2. *Repetition.*—Learn 10 to 20 lines per week till known. As with reading, saying the words is of little use. Emphasis, modulation, and a thorough knowledge of the meaning are necessary.

3. *Teaching.*—Chap. iv., *Scholarship School Management:* The Teaching of Reading.

In dealing with the various subjects of the school curriculum, the first point to notice is whether they are taught for their practical utility or as a means of mental training. If the young teacher appreciates thoroughly why the lesson is given, the teaching will be much better than it otherwise would be.

Note particularly what is said about the various systems, and learn verbatim the table showing the qualities of good reading. The various stages in a reading lesson is another important topic.

4. *Drawing.*—I have to repeat, at the risk of being wearisome, the advice given each month. The copies must fill fairly a half imperial sheet—that is, 22″ × 15″. A drawing about 6″ × 4″ is quite useless. In answer to several students, I gave in the January number a list of reliable copies. These are essential to success.

5. *Music.*—Pulses, measures, divisions into halves, quarters, and thirds.

There is little to learn in this, but great care must be taken in the method of writing, usually one of the weakest points. The bars must be perpendicular. The point to mark the half pulse must be placed in the centre, and the comma half-way between the centre and side. Thus, | d , r . m : is wrong, and should be | d , r . m : A little study of printed solf-fa will illustrate this more fully. The only exception is in writing three-quarters of a pulse. In this case the point does not occupy the centre—for example, | d .,r :

6. *Penmanship.*—Ten minutes' daily practice in the *Practical Teacher Copy Book.* Let me remind students that they should use a good pen and good ink, and keep to the same kind of pen.

7. *Composition.*—Write one or two essays each week on such subjects as—

(*a*) The teacher's life: its ideals and difficulties.
(*b*) The effects of the feudal system on English life.
(*c*) "Still waters run deep."
(*d*) Use and abuse of advertisements.
(*e*) The benefits to be derived from nature study.
(*f*) The character of some great man.
(*g*) The British Empire.
(*h*) Modern means of communication.

A skeleton plan must be prepared for each. Read up the subject if necessary, but do not copy extracts. When submitting an essay for criticism, the analyses should be given. Divide the essay into paragraphs, each dealing with one phase of the subject.

The subjects given above are simple, and should need very little preparation. (*b*) is based, of course, on history. (*c*) should be treated as indicated last month—(1) the literal meaning; (2) the wider meaning, explained and illustrated by examples. (*d*) Uses. These are obvious: sale of goods, positions vacant and wanted, notices of meetings, etc. The abuses are that many things are advertised which are best unknown, and that may appeal to the credulity of the public, and are palpable frauds. (*e*) There should be no difficulty with this. Apart from the mere mental training in close observation and reasoning, there is a keen pleasure in discovering some of nature's secrets, and appreciating the exquisite beauty of form and design in everything. That every one does not experience this pleasure is due to the fact that very few, comparatively, take the trouble to look. (*f*) An analysis of character is wanted, *not* a life. Take the good qualities and then the defects, quoting instances in the life to prove your point. (*g*) This may be treated in many ways—the extent, the growth, the character of the government, etc. (*h*) needs no explanation.

8. *English.*—(1.) Learn twenty-five roots and meanings each week.
(2.) Prepare thoroughly the grammar and syntax of the *Verb.*
(3.) *The Task*, Book V., lines 127–160.
(4.) *As You Like It*, Act II., Scenes ii.–v.
(5.) Elizabethan literature.

Notes on English.

The Verb.

The grammar of the verb must be very carefully prepared. Exact definitions of the terms transitive, intransitive, regular, irregular, voice, mood, tense, participles, etc., must be entered in notebook and committed to memory. Note the following:—

(1.) *Auxiliary verbs* are used to form some mood, tense, or voice, or an alternative form of one of them—for example, *I do go* and *I go* mean the same when *do* is not emphatic. *May* and *might* (in the sense of giving permission), *can* and *could*, *ought*, *let*, are not auxiliaries.

(2.) *Defective verbs* are those which are deficient in some of their moods or tenses. Of some verbs we have only one form remaining—for example, *worth* ("Woe worth the day"), *dight*, *ought*, etc.

(3.) *Impersonal verbs* are those of which the subject is impersonal—"*It* rains," "*It* is evident that *it* will snow."

(4.) *Causative verbs* is a term applied to transitive verbs made from intransitive, and expressing the cause of the action. Compare *The tree fell* and *I felled the tree*; *The boy rose* and *He raised the boy*, etc.

(5.) *Voice.* Only transitive verbs have voice. Some grammarians recognise a middle voice—as, for example, *The door opened*, but here the verb is really intransitive.

(6.) *Mood.* The infinitive mood is the verb (with or without *to*) used without limitation by a subject.

The infinitive without *to* is only used after auxiliaries of mood and tense, or in forming part of an object. The infinitive with *to* is used after principal verbs—*I hope to go.* The infinitive is used also (*a*) as a noun, forming subject or object—for example, *To err is human*; (*b*) to qualify a noun—*Bread to eat, water to drink*; (*c*) to limit an adjective—*Easy to see, quick to learn.*

The subjunctive mood is the most difficult to understand, because it follows no definite rules. The tendency at the present time is to cease using it. It is also confused with the conditional indicative. Thus, "If it is raining" is indicative conditional; "If it were to rain" is subjunctive. The subjunctive mood may be defined as that part and form of the verb used to express pure hypotheses which exist only in the speaker's mind, or are regarded as possibilities, not facts.

(7.) *Tense.* The simplest classification of tenses is—

Present.	*Imperfect.*	I am writing, *or* I write.
	Perfect.	I have written.
Past.	*Imperfect.*	I wrote, *or* I was writing.
	Perfect.	I had written.
Future.	*Imperfect.*	I shall write, *or* I shall be writing.
	Perfect.	I shall have written.

Note the difference in *shall* and *will*. Dr. Morris's lines point this out :—

"In the first person simply *shall* foretells,
In *will* a threat or else a promise dwells.
Shall in the second and third does threat,
Will simply then foretells a future feat."

(8.) *Participles.* Distinguish between the imperfect participle (usually used after the noun to which it relates) and the adjective (used before the noun). There is considerable difference between a *ship sailing* and a *sailing ship*, a *dining-room* and a *room dining*, a *walking-stick* and a *stick walking*. *Sailing*, *dining*, *walking* are disguised gerunds in these cases, and equal *for sailing*, *for dining*, etc.

(9.) The *Gerund* is the imperfect participial form taking the place of a noun—for example, *On entering the warehouse*. Here *on* governs the gerund *entering*, which, being transitive, governs the noun *warehouse*.

The gerundial infinitive is the infinitive expressing purpose—for example, "He went *to see*." This used to be governed by a preposition—"What went ye out *for* to see?"

(10.) The defective verbs should be noted.

"As You Like It."

Act II., Scene ii.—*Roynish* = roguish.

Let not search and inquisition quail = let there be no slackness in the search, and let nothing interfere with its being thorough.

Scene iii.—*Bony priser*, a strong man who competes for prizes. Some editions give *bonny*, which, besides being out of keeping with Adam's views with regard to him, is much weaker.

Humorous, changeable ; fickle.

Use to lie, are accustomed to lie. We use the past tense of this, but not the present.

No matter whither. Read, "It is no matter whither thou goest."

Thrifty hire. Here, saved by thrift.

O good old man, etc. The meaning is, "You are a good example of the fidelity with which men served their masters in bygone times, when a man did his utmost for a master because he felt it was his duty, and not for the sake of the wages received. Nowadays men work only for their own advancement, and having obtained their desires, cease any further effort."

With the having. *Having* is a gerund, objective case, governed by *with*.

Thou prunest a rotten tree, etc. = you are taking great care with something which cannot repay you.

Youthful wages, wages saved in youth.

Settled low content = some lowly place of settlement where we shall be contented.

Too late a week. Not "too late by a week," but generally "much too late." *Week* is adverbial object.

Scene iv.—*I should bear no cross*, refers to the fact that silver coins of the time were stamped with a cross.

Doublet and hose, the usual male dress—the doublet (a short jacket) and long hose reaching to the thighs.

Corin, *Silvius*, common pastoral names.

Phantasy, fancy—Greek, *phantasia*.

Wearing thy hearer = wearing out the patience of ; tiring.

Searching of thy wound. *Of* is redundant. "I, searching thy wound, have found mine own."

And I mine, etc. = if Touchstone's legs are weary, his wit is not. This speech, mimicking Rosalind's sentimental remark, is exquisite foolery.

A-night. *A* is the old preposition = on.

Battel, the wooden bat used in beating linen.

Wooing of a peascod. The peascod or husk was used in wooing, but not to be wooed. The old practice was for a lover to snatch one from the growing plant ; and if the peas all remained in, it was a sign of good omen, and he gave it to his lady love.

Weeping tears. This is, of course, mere burlesque.

As all is mortal, etc. = as all living things are mortal, so every one in love is deadly foolish.

I shall ne'er be ware, etc. = I shall never be aware that I am wise till I am unexpectedly brought to see it.

Jove, Jove, etc. Rosalind is apparently quoting some ballad.

He's not thy kinsman = he is not a fool as you are.

What is he, etc. Not "Who is he?" but "What rank is he?" "What is his position?" etc.

Scene v.—*Dog-apes*, monkeys, or perhaps dog-faced monkeys, like baboons. Jacques means that two people making empty compliments to each other are like two monkeys grimacing.

Cover the while = lay the table while I am singing.

Too disputable, too fond of wordy arguments. Jacques claims that he thinks as much as the duke, but is not fond of arguing.

Seeking the food he eats—that is, procuring his own food by hunting, etc. ; not depending upon some one else for it, as people do in towns. Jacques' addition to the song is a sarcasm on the lords who have given up everything to follow the duke.

Ducdame. Editors of Shakespeare have made endless suggestions as to the meaning and origin of this, but probably it is only a coined word, meaning nothing.

First-born of Egypt. Some commentators say this means "all persons of high rank ;" but there may be a covert allusion to the first-born duke (the elder one), and Jacques is vexed with him for allowing him to be driven from his duchy.

Elizabethan Litera'ure.

It is, of course, impossible to study this thoroughly in a month, but students should be quite clear on several important points. It can hardly fail to strike the most casual reader with surprise that whereas before this period there were very few writers, by the end of Elizabeth's reign there was such a "choir of singing birds" —Shakespeare, Marlowe, Greene, Ford, Massinger, Fletcher, Beaumont, Spenser, Sidney, Raleigh, etc., as dramatists and poets ; Sidney, Hooker, Raleigh, Bacon, etc., as prose writers. Why this sudden outburst? The revival of learning, or, to use a better term, the Renaissance—the new birth—the great church dispute, the discoveries of foreign lands, the increased prosperity and wealth of England, all combined to produce thinkers and students. Again, the rise of the drama in a few years from the crudest comedy to the lofty excellence of *Hamlet*, *Lear*, etc., is most striking. Why was this? The drama had its origin in those scriptural plays—"Passion Plays," "Miracle Plays," "Mystery Plays"—with which the church endeavoured to acquaint the uneducated with some of the leading events of the Bible by presenting them in the form of a drama. Originally acted with gravity and religious feeling, they soon, by the inclusion of the devil and imps, vices and virtues, degenerated into mere spectacular displays, in which the solemn truth was hidden by grotesque incidents. The Passion Play at Ober Ammergau is an example of the best kind of Passion Play. In the dull, uneventful life of the thirteenth and fourteenth centuries, these periodic representations were eagerly looked forward to and keenly enjoyed ; and it is not to be wondered at that when the monasteries were abolished, the public generally should wish for something to take the place of the religious play, and that writers should turn from religious incident to the hardly less interesting historical event, or to some of the many tales and legends which were fairly familiar.

It must, however, be borne in mind that "play-acting" was regarded as a low form of occupation, and especially so to the grim Puritan. "Rogues, vagabonds, and play-actors" are classed together in some of the old acts of the period. The theatre was a barn, an open green, or the square courtyard of some country inn. In London the first theatre erected consisted of a semi-circular gallery, a pit open to the sky, and the stage, which was entirely destitute of appropriate scenery. Well-to-do playgoers could be accommodated with seats on the stage, whence they could chat with the actors. What Shakespeare's sensation would be to see one of his plays staged as it is in a modern theatre one can hardly think. The dramatists as a class were brilliant young men who spent money as fast or faster than they earned it, and died in destitution. Shakespeare is the only one of them who made money and retired from the theatre in prosperous circumstances.

The study of Latin and Greek led to the direct introduction of many new classical words. Some of them remained, but many were dropped in favour of the simpler, homely Saxon terms. John Lyly, in his *Euphues*, set the fashion of writing and speaking in stilted, extravagant terms—a form of speech known as Euphuism. The following verse will illustrate this :—

"As on my way I itinerated,
A rural personage I obviated.
Interrogating time's transition,
And of the passage demonstration,
My observation did ingenious scan
That he was merely a simplitian."

Done into English this is, "As I went on my way I met a rustic. On asking him the time and the way, I found out he was a very simple fellow."

9. *Geography.*—

(1.) The British possessions in Africa (excluding South Africa).

(2.) Revise Asia generally. Asia Minor, Persia, and Arabia.

The character and government of the British possessions in East and West Africa are generally not well known. Copy the following table into notebook and learn :—

WEST AFRICAN POSSESSIONS.

COLONY.	AREA IN SQUARE MILES.	POPULATION.	PRODUCTS.	TOWNS.	GOVERNMENT.
1. Gambia	2,700 (with Protectorate).	13,456	Ground nuts (nine-tenths), bees'-wax, rubber, hides. (Value, £250,000.)	Bathurst.	Crown Colony (1888). Governor and Legislative Council.
2. Gold Coast Colony	46,600	1,500,000	Gold, rubber, ivory, gum-copal, monkey skins, cotton, camwood, grains, and oil. (Value, £500,000.)	Accra, Cape Coast, Elmina, Addah, Saltpond, Quitta.	Crown Colony (1874). Governor and Legislative Council, six official and three unofficial members.
3. Sierra Leone	4,000	76,655	Palm kernels, kola nuts, cocoa nuts, ginger, ground nuts, indiarubber, hides, bees'-wax. (Value, £300,000.)	Freetown.	Crown Colony. Governor and Legislative Council, five official and three unofficial members.
4. Sierra Leone Protectorate	30,000	500,000	Palm kernels, kola nuts, cocoa nuts, ginger, ground nuts, indiarubber, hides, bees'-wax. (Value, £300,000.)	..	..
5. Lagos — Colony	4	50,000	Palm kernels, kola nuts, cocoa nuts, ginger, ground nuts, indiarubber, hides, bees'-wax. (Value, £1,000,000.)	Lagos.	Crown Colony. Governor and Council.
5. Lagos — Protectorate	267,000	2,000,000			
6. Southern Nigeria	5,000	100,000	Palm kernels, kola nuts, cocoa nuts, ginger, ground nuts, indiarubber, hides, bees'-wax. (Value, £1,250,000.)	Old Calabar, Opobo, Bonny, Brass, Benin, Akassa.	Crown Colony. Governor and Council.
7. Northern Nigeria	310,000	30,000,000		Lokoja, Zungeru.	Protectorate under High Commissioner.
EAST AND CENTRAL AFRICA.					
1. Somaliland Protectorate	90,000	?	..	Berbera, Bulhar, Zeila.	Protectorate under Commissioner.
2. East Africa Protectorate	1,000,000	4,000,000	Ivory, grain, rubber, copra. (Value, £113,000.)	Mombasa.	Protectorate under Commissioner.
3. Uganda Protectorate	70,000	243,000,000	Ivory.	Uganda.	Protectorate under Commissioner.
4. Zanzibar Protectorate	985	250,000	Ivory, cloves, copra, rubber, gum-copal. (Value, £1,100,000.)	Zanzibar.	Protectorate under Commissioner of East Africa Protectorate.
5. British Central Africa Protectorate (Nyassaland)	..	845,000	Coffee, rubber, ground nuts, millet, and tobacco. (Value, £21,000.)	Blantyre, Zomba.	Protectorate under Commissioner.

A map should be drawn, the position of these colonies marked, and all the towns mentioned inserted.

Note that a railway is being constructed from Mombasa to Uganda.

10. *History.*—Edward I., Edward II., Edward III., and Richard II.

Edward the First's policy may be divided into two sections—(1) He determined to bring the whole island under one rule; and (2) he determined to reform the laws, and placed the administration of justice on a sure footing.

In accordance with this we have the conquest of Wales, and the interference in Scotch affairs and the practical conquest of that country. The events in connection with these wars must be thoroughly learned. Note exactly the claims of Balliol and Bruce. Balliol was of the elder branch, but one degree further removed than Bruce, as the table shows—

DAVID, 1124–1153.
|
Henry, Earl of Huntingdon.
|
David, Earl of Huntingdon.
|
Margaret *m.* Alan of Galloway. — Isabella *m.* Robert Bruce.
|
Devorguilla = John Balliol. — *Robert Bruce*, d. 1295.
|
John Balliol, 1292–1296.

Judicial Reforms.—Edward is sometimes called the English *Justinian*, from Justinian, Emperor of the Eastern Empire, who codified and issued the Roman laws. Edward's chief statutes, etc., were:—

1275. First Statute of Westminster.—(*a*) Codified and affirmed preceding statutes. (*b*) Provided for freedom of election. (*c*) Limited the amount of feudal aids.

1278. Statute of Gloucester.—(*a*) Regulated proceedings of the Manor Courts. (*b*) Issued *Quo Warranto* writs, calling on the barons to show by what right they held certain lands.

1279. Statute of Mortmain.—Forbidding the alienation of land to the church which defrauded the king of rights and service.

1284. Statute of Wales.—Introducing English law into Wales.

1285. Second Statute of Westminster.—(*a*) *De Donis Conditionalibus*, instituting the Law of Entail, by which a man could not sell his land to the detriment of his heirs. (*b*) Two sworn judges to hold assizes three times a year.

1285. Statute of Winchester.—(*a*) Providing for better local government—for example, gate of town to be closed at sunset; towns to be watched all night; sides of highways to be cleared; two constables to be chosen in every hundred to report to a justice assigned for the purpose (origin of Justices of Peace). (*b*) *Circumspecte Agatis*, limiting the jurisdiction of spiritual courts to purely religious matters.

1290. *Quia Emptores*, to prevent sub-infeudation.

1297. *De Tallagio non concedendo*, refusing to allow the king to levy tallages.

The law courts were also reformed. The judicial functions of the *Magnum Concilium* devolved on the *Curia Regis*, and then on a body of judges, but there had been no attempt to classify cases and institute separate courts. Edward in the early years of his reign set up the following:—

(*a*) Court of Exchequer, to deal with cases affecting the revenue.

(*b*) Court of Common Pleas, to deal with cases between subjects.

(*c*) Court of King's Bench, to deal with cases between subject and crown.

A distinct staff of competent judges was assigned to each.

Edward the Second.—The chief events are:—

(*a*) The misrule of the king and his favourites: consequent complaint of the nobles, culminating in the appointment of Lords Ordainers, 1310.

(*b*) The Scotch War and the battle of Bannockburn. (Prepare a plan.)

(*c*) The Despensers. Deposition and death of the king.

Edward the Third.—(*a*) The Scotch War: battle of Halidon Hill.

(*b*) The Hundred Years' War. Note particularly the causes—

The help the French under Philip the Sixth had given to the Scots.

Continued ill-feeling between the countries.

The dispute about Flanders—*the real cause*. The staple export of England was wool, which was sent to Flanders to the great manufacturing towns Antwerp, Bruges, Ghent, etc. These towns had risen in revolt against the Count of Flanders, and he, unable to reduce them, had called for the assistance of his superior the King of France. If they succeeded in quelling the revolt, the import of wool would be stopped. Edward sent the towns aid, and, to secure the assistance of some nobles of doubtful allegiance to the French king, put forward his *claim* to the throne of France. The latter was a *result* rather than a cause.

Plans of Crecy and Poitiers must be learned.

(*c*) The Black Death and Statute of Labourers. (Most important.)

(*d*) Statutes.—1351. *Provisors*—Against the claim of the Popes to the right to present to vacant benefices.

1352. *Treason*—Limiting the crime to six definite acts. (Since the estates of a man attainted of treason reverted to the king, it was to his interest to interpret the term as widely as possible.)

1353. *Præmunire*—To prevent any case being carried out of England without the king's knowledge and consent.

1353. *Staples*—Appointing fixed towns as markets.

(*e*) The misgovernment at end of reign and the Good Parliament.

Richard the Second.—(*a*) The Peasants' revolt—of immense importance—marks the change from the holding of lands on military tenure to the payment of rent. Study this *well*.

(*b*) The king's misrule. Lords Appellant.

(*c*) Deposition. Causes.

11. *Arithmetic.*—Revise ratio and proportion, and work Nos. 151–200, Christian and Collar. General examples.

The theory of ratio and proportion is explained very fully in the text-book, and must be mastered. Note particularly that *ratio* can only exist between quantities of the *same* kind.

12. *Algebra.*—Harder equations and problems (Hall and Knight).

13. *Euclid.*—Revise 31–40, Book I., with six deductions per week.

14. *Elementary Science.*—Radiation. This section is treated fully in any good text-book, but if anything is not clearly understood students must write for assistance.

15. *General Information.*—Work one paper a week from one of the books of questions published.

Notes on the February Paper.

1. *Wireless Telegraphy.*—Many students have very hazy ideas on this point. It is supposed (but not proved) that there is a substance called *ether* which permeates everything, so that two molecules are never in contact, but are always surrounded by this medium. It is imponderable, and fills all space. It is not a fluid, but rather resembles a jelly which has the power of transmitting waves with great rapidity. It is the medium, too, by which light and heat are radiated, but *not sound*. An electric discharge sets up waves in the ether which diminish in force as the square of the distance, but which proceed rapidly in all directions to a great distance. The Marconi apparatus consists of two parts—(*a*) the transmitter, and (*b*) the receiver. The former is an arrangement for causing electrical discharges between brass balls connected with a wire which is carried high into the atmosphere. Every time a spark passes a wave is started. These waves are not strong enough to cause a current in a wire at a great distance, but they are strong enough to cause metallic dust to cohere and so become a conductor, which brings into play a powerful battery which registers the signal. By varying the strength of the discharges, waves of different power are excited, and hence messages may be transmitted by the Morse code.

2. *Impurities of Water.*—These should be tabulated. The majority of answers were incomplete because this was neglected.

(1.) Inorganic
- (*a*) Gases in solution—for example, O, Co_2, H_2S, NH_3, etc.
- (*b*) Solids in solution—salts of lime, magnesium, potassium, iron, etc.
- (*c*) Solids in suspension—dust particles, or finely-divided rock material.

(2.) Organic
- (*a*) Gases given off from decaying animal and vegetable matter—for example, sewer gas.
- (*b*) Solids
  - (1) living—germs, animalcula, eggs of insects, etc.
  - (2) dead—bodies of above, particles of plants, etc.

3. The pairs of words were distinguished properly, except *later* and *latter*, *farther* and *further*.

Later is second in point of time.
Latter is second in point of mention.

Farther, the comparative of *far*, is generally used with regard to distance—for example, "He went farther (a greater distance) than I."

Further, the comparative of *forth*, is generally used with regard to degree—for example, "He carried the argument further."

But it must be admitted that many standard writers seem to use them indiscriminately.

Test Paper on General Information.

The answers to these questions are marked gratis. They should be written on foolscap, on one side only, the coupon of the current number and a stamped addressed envelope for return enclosed.

All papers must be sent to Mr. A. T. Flux, The Bays, Belvedere, Kent.

A prize of One Guinea will be given to the student securing the highest percentage of marks.

1. What is the difference between *aid* and *help*; *habit* and *custom*; *compliment* and *complement*; *dissimilar* and *distinct*; *canon*, *cañon*, and *cannon*; *effect* and *affect*?

2. What are the six Great Powers? Give approximately the size of the army of each.

3. Why are fire-irons kept polished and stoves painted black? Which would be warmer to wear in winter—a white woollen coat, and a similar one dyed black?

4. Describe the process of digestion.

5. Why may plants be kept with advantage in a sitting-room, but not in a bedroom?

6. What is meant by a "corner" in commerce, and a "run" on a bank?

7. What are sassafras, cochineal, sago, cinnamon, copra, gum-copal, and assafœtida?

8. What historical events are connected with Rubicon, Thermopylæ, Fotheringay, Borodino, Sedan, Khyber Pass, Torres Vedras, and Vinegar Hill?

Test Questions on Last Month's Work.

1. *Penmanship.*
Large Hand.—*National Assembly.*
Small Hand.—*Worth makes the man, and want of it the fellow.*

2. What uses may be made of a blackboard in teaching?

3. Name the following intervals—

t–fe, de–ra, r–se, la–d', fe–ta.

4. Write an essay on—

"The heights by great men reached and kept
Were not attained by sudden flight;
But they, while their companions slept,
Were toiling upward in the night."

5. Analyse the following, and parse words in italics:—

"I do beseech your grace,
Let me the knowledge of my fault *bear* with me:
If with myself I hold intelligence,
Or have acquaintance with *mine own* desires:
If that I do not dream and *be* not frantic—
As I *do* trust I am not;—then, dear uncle,
Never so much as in a thought unborn
Did I offend your highness."

6. What states are comprised in the Balkan Peninsula? Give the constitution and capital of each.

7. Point out what advantages have accrued to India from being under British rule.

8. What do you know of Henry the Second's legal reforms?

9. Trace the growth of the Parliament from 1066 to 1295.

10. Work the following:—

(1.) Ten cubic metres of manure are spread evenly over a square kilometre of land. Find the thickness of the layer in millimetres. Ans. ·001.

(2.) If a farmer lays two tons of lime on an acre of land, how many grammes is that per square metre? Assume the result correct to the nearest integer. (1 metre = 39⅜ in.; 1 kilogramme = 2¼ lbs.) Ans. 503 grammes.

(3.) Assuming that a cubic metre contains 1000 litres, and that a linear metre contains 39·4 inches, how many cubic inches are there in 25 litres? Ans. 1529·0746.

(4.) If 3 kilometres are as much under two miles as 5 kilometres are over 3 miles, what is the length of a kilometre?

Ans. 1100 yards.

11. (Boys)—Work the following:—

(1.) Show that—

$$\frac{x}{(x-y)(x-z)}+\frac{y}{(y-z)(y-x)}+\frac{z}{(z-x)(z-y)}=0.$$

(2.) Simplify— $\dfrac{m-n-2n\dfrac{m-n}{m+n}}{\dfrac{m-n}{n}\div\dfrac{m+n}{m}}$ and $2+\dfrac{x}{3+\dfrac{x^2}{4}}$.

Ans. $\dfrac{n(m-n)}{m}$; $\dfrac{x(3x^4+4)}{x^6+6x^4+8}$.

(3.) Simplify—

$$\frac{\dfrac{a^2}{b^2}+\dfrac{b^2}{a^2}-2}{\dfrac{a^2}{b^2}+\dfrac{b^2}{a^2}+2}\div\frac{\dfrac{a}{b}\left(1-\dfrac{b^2}{a^2}\right)}{\dfrac{(a+b)^2}{ab}-2}.$$ Ans. $\dfrac{a^2-b^2}{a^2+b^2}$.

(4.) Simplify—

$$\frac{(x-y)^4-xy(x-y)^2-2x^2y^2}{(x-y)(x^3-y^3)+2x^2y^2}.$$ Ans. $\dfrac{x^2+y^2-4xy}{x^2+y^2}$.

12. What is capacity of heat? What part does the great capacity of heat of water play in the economy of nature?

PUPIL TEACHERS' COURSE.

For Candidates Examination, 1903.

The short time remaining should be spent in revision. The following points must be carefully attended to:—

1. *Arithmetic.*—Make quite sure of accurate definition of all terms employed—for example, numeration, notation, factor measure, G.C.M., L.C.M., prime number, composite number, multiplicand, dividend, fractions—proper, improper, compound, complex, vulgar, decimal—ratio, proportion, etc. The candidate should also be prepared to prove the addition, subtraction, multiplication, and division of fractions by means of diagrams, and to answer such questions as—

(1.) Prove that seven times nine = nine times seven.

(2.) What vulgar fractions can be expressed as finite decimals, and why?

(3.) With a recurring decimal, is there any limit to the number of digits recurring?

(4.) In what sense does $\dot{9}=1$?

(5.) What is wrong in this statement?—As 2 books : 5s. :: 4 books : 10s.

(6.) In finding the L.C.M. of 10, 15, 30, 32, 36, why may we erase 10 and 15?

(7.) Prove that a fraction is divided by a whole number when its denominator is multiplied by that number.

(8.) Resolve 6006 and 7854 into their prime factors, deduce their G.C.M., and prove that it is their G.C.M. (To do the latter part, divide each number by the G.C.M., and show that the two quotients have no common factor.)

(9.) How would you prove to children that 27 cubic feet make a cubic yard?

(10.) How would you explain to a class beginning fractions the error in the following?—

$$\frac{3}{4}+\frac{2}{7}=\frac{3+2}{4+7}=\frac{5}{11}.$$

(11.) Prove that $\frac{1}{7}$ of $3=\frac{3}{7}$ of 1; that if A is $\frac{5}{6}$ of B, B is $\frac{6}{5}$ of A.

(12.) By what method would you enable children to ascertain whether a given number is prime (for example, 163)?

In the examination take care to set the sums down neatly, and to give full explanation of the working.

The paper set for candidates can generally be answered in ten minutes, *if* questions are carefully examined.

For example, a complex fraction like this was set:—

$$\frac{41\frac{3}{4}\frac{7}{5}-13\frac{1}{7}\frac{5}{7}}{41\frac{3}{4}\frac{7}{5}-13\frac{1}{7}\frac{5}{7}}.$$

In one examination centre every candidate worked it out at great length, instead of immediately putting the answer down as 1.

2. *English.*—Every candidate should now be quite sure of the analysis and parsing of the poems, and of the meaning of every line and word.

In analysis, the relation of the sentences must be expressed fully—for example, "This is the house that Jack built."

This is the house. Principal sentence to No. 2.

That Jack built. Subordinate sentence to No. 1. Adjectival to *house.* ("Adjectival to No. 1" is wrong.)

With a question on suffixes, tabulate. Show use and meaning, for example:—

	Suffix.	*Meaning.*	*Use.*
Motherless	= less	= without	= forming an adjective from a noun.
Length	= th	(abstract quality of)	= forming a noun from an adjective, *long.*

Exact definition of all common grammatical terms should be learned.

The composition will be on the subject of the prescribed book. The following are possible topics:—

(1.) The Life and Works of Gray.

(2.) Write an essay on the substance of the *Elegy.*

(3.) Give in your own words the epitaph with which Gray ends the poem.

(4.) Give in your own words the substance of the *Ode on the Spring.*

3. *Geography.*—The chief points have been dealt with in the course. Revise particularly the towns, imports, and exports. In the general geography the following points should be prepared:—Longitude and latitude, day, night, and the seasons, climate and the causes affecting climate, winds, tides, ocean currents.

The following Government questions will help in revision:—

Questions on the British Isles.

(1.) Which are the most mountainous parts of England? Show by examples how the elevation of the land affects the length and direction of the rivers.

(2.) Give an account of the physical features of Devon, Warwickshire, Derbyshire, and Durham.

(3.) What do you know of Black Country, Fens, New Forest, Lake District, Peak, and Downs?

(4.) Contrast the eastern and western shores of England.

(5.) What physical advantages ought commercial rivers to possess? Name some which do.

(6.) Name the mountain systems of England. Which are remarkable for their extent and beauty?

(7.) Name the leading industries of England, and give reasons why each should be placed in its particular seat.

(8.) What districts are noted for the manufacture of lace, carpets, locomotives, glass, leather, earthenware, and linen, smelting of iron, quarrying of slate, lead, and copper?

(9.) Name the chief ports in England. Point out their position and chief exports.

(10.) Describe the situation and character of the Highlands.

(11.) Name three rivers in Scotland, where they rise, towns on their banks, and commercial importance.

(12.) What do you know of Sumburgh Head, Stornoway, Berwick, Oban, Dundee, Aberdeen, Balmoral, Kyles of Bute, Crinan Canal, St. Andrews?

(13.) What is meant by the Hebrides? Make a list, and give an account of Skye.

(14.) Describe the situation and character of Connemara, Bog of Allen, Giant's Causeway.

(15.) What do you know of Londonderry, Valentia, Queenstown, Kingstown, Belmullet, Killarney, Limerick, Galway, Cork, Coleraine?

(16.) Describe a voyage down the Shannon.

(17.) What do you know of Liverpool, Manchester, Hull, Leeds, Swansea, Bristol, Oxford, Reading, King's Lynn, Cromer, Newark, Rhyl, Aberystwith, Harwich, Margate?

(18.) What do you know of Ben Nevis, Cairngorm, Helvellyn, Malvern Hills, Loch Neagh, Sound of Mull, Loch Lomond, Stonehenge, Windermere?

(19.) What do you know of Alnwick, Buxton, Darlington, Oban, Penrith, Rothesay, Stirling, Taunton?

(20.) What parts of Great Britain are noted for hops, apples, wheat, copper, tin, blacklead, granite, slate, rock-salt, and jet, salmon, oysters, pilchards?

(21.) Where and what are Cape Clear, Malin Head, the Lothians, Cross Fell, Wrekin, Weald, Tarbet Ness, Minch, Mull of Galloway, Belfast, Crewe, Doncaster, Dundee, Grantham, Holyhead, Kilmarnock, Galashiels, Caledonian Canal, Dogger Bank, Goodwin Sands, Hartland Point, Needles, Bournemouth, Ely, Reading, Cheltenham, St. Andrews, Dartmoor, Chesil Beach, Iona, Sunderland, Peterhead, Droitwich?

(22.) Where are the following carried on:—Shipbuilding, paper-making, glass-making, boot and shoe making, straw plaiting, carpet weaving?

4 *History.*—What time is left for revision should be spent in committing to memory the notes made during the year, especially the dates and summaries of leading events. It is also a good plan to revise under certain definite heads—for example, the wars, dates, causes, effects, and treaties; chief statutes, rebellions, brief lives of the leading characters, etc.

5. *Music.*—Not a single mark should be lost in this subject. The syllabus is very limited in scope. The pitch names, mental effects, must be known. Answers to the following should be prepared if not already known:—

(1.) What is a scale? (A progression of eight notes, with semitones between the 3rd and 4th, 7th and 8th, if a major scale; between the 2nd and 3rd, 5th and 6th, if a minor.)

(2.) What are strong tones, leaning tones, a measure, a pulse?

(3.) What is pitch? (A musical note is produced by a regular series of vibrations. Thus a tuning-fork vibrating 256 times per second produces the note **doh**; 512, **doh**^{1}. Different vibrations give different notes, and this variation is called pitch.)

(4.) What is the difference between primary and secondary measures?

(5.) Rewrite the following, halving the value of each note and rest, doubling the value of each note and rest.

(Any passage in 2, 3, or 4 pulse measure may be taken for practice.)

Next month we shall commence a new course for the Candidates Examination, 1904.

First Year, 1904.

In commencing a new course, I should like to point out to pupil teachers that they will get most assistance by writing for help in all cases of difficulty. It is impossible to explain every possible difficulty in these notes. I should be glad if intending students would send me their names and addresses.

As the new Code is not yet issued, particulars as to special books, etc., will be postponed till next month, but in the meantime students will do well to commence work on the lines below.

1. *Reading.*—This must not be limited to the prescribed book. A pupil teacher who reads only the three or four prescribed books during apprenticeship will find it impossible to answer the questions in General Information in the Scholarship Examination, besides being deficient in that wide store of general knowledge which is invaluable in all papers. The class of books read should be useful books—that is, those containing information—and may be historical novels, tales of exploration, biographies of great men, essays—anything, in fact, which has a good reputation. As for novels of the erotic type, they are best left alone. An invaluable assistance to the reader is a commonplace book, in which any striking particulars or facts, newspaper cuttings, etc., may be entered. If this is indexed, the student will collect in a few years a vast store of most useful information.

I will gladly send to any student a list of books which may be read with advantage.

2. *Penmanship.*—Continual care must be taken with this subject. The *Practical Teacher Copybook* (used by the first girl on the Scholarship List, lately issued) has been specially prepared to provide a sensible style of writing, with exact instructions as to size, etc., and abundant material for practice.

3. *Geography.*—The physical features of Europe. Draw a large outline map as correctly as you can. In it insert all the names you meet with in your text-book, and then go over the names until you can reproduce the map *from memory*. Until you can do this you do not know your work. Get a clear idea of the general elevation of the country; note the latitude. This will assist you in estimating the climate and productions. Any peculiarity in the country should also be noted—for example, the fjords of Norway, the Dogger Bank, the tundras in the north of Russia, the steppes in the south, the landes in France, etc. Why does the Baltic contain water fresher than the sea, the Mediterranean salter? Which rivers are useful for navigation, and which are not?

4. *History.*—Alfred to 1066. Digest the accounts given in text-book into notebook, and learn verbatim. The following are notes on some salient points:—

(1.) Why was Alfred called the Great?

(*a*) His personal qualities.—Courage, patriotism, perseverance, patience, piety, etc., endeared him to his people.

(*b*) A successful warrior.—Beat the Danes at Exeter, Ethandune, Farnham, etc.

(*c*) A legislator.—Codified the laws, and saw they were properly administered.

(*d*) An educationist.—Translated books, built monasteries, founded schools, obtained services of wise and learned men.

(*e*) A reformer.—Reorganised the fyrd—half to be at home, and half on military duty. Founded the navy, building ships longer and stronger than the Danes.

(*f*) A politician.—In his treatment of the Danes (Treaty of Wedmore, settlement of the Danelagh).

(2.) Terms in Saxon England.

(*a*) Divisions of the land.—Shire, hundred, tithing. Folcland (folkland, land held in common), bocland (bookland, land held by written document—charter, personal estates).

(*b*) Government.—Witanagemote, the meeting of wise men. Shire moot, meeting of the shire presided over by the bishop, earl, sheriff. Folcmoot, the parliament of a township. Hundredmoot, the parliament of a hundred. Hallmoot, the court of law held in the hall of a thane or earl.

(*c*) Criminal practice.—Compurgation. Trial by ordeal. Wergild (amount paid as fines for murder, etc.). Frankpledge.

(*d*) Grades of society.—The king, elected by the Witan. Athelings or princes, properly sons of the king. Ealdorman or alderman—afterwards displaced by the Danish term *earl*—the ruler of a district. Thegn or thane, the private gentleman, holding land of his own. Ceorl, the freeman, farming a hide (30 acres) of land. Socman, the labourer, holding five acres on terms of service. Serf or thrall, the bondman or slave.

(3.) Dunstan's aims and policy.

(4.) Causes leading to the Norman Invasion.

5. *Arithmetic.*—Partnership, etc., Christian and Collar, Ex. 90 and 91.

Many of the examples in Ex. 91 are difficult. Any that cannot be solved should be sent up.

6. *English.*—For this month prepare the prefixes thoroughly.

7. *Music.*—Transposition.

8. *Science.*—Heat, what it is. Radiation, convection, conduction, expansion by heat.

In addition to the subjects of the syllabus, all pupil teachers should take up a language, preferably French. Arrangements will be made for giving assistance with this if a sufficient number notify their intention to follow the notes.

Second Year.

1. *Reading.*—(See note under First Year.) For this month read two or three of Macaulay's *Essays* (Clive, Hastings, Frederick the Great).

2. *Penmanship.*—(See notes above.)

3. *Geography.*—Prepare the physical features of Africa. Draw a map, insert all names, and practise till known. Note the following:—

(1.) Why is Africa called the Dark Continent?

(*a*) Either because it is the home of the negro—the black man;

(*b*) Or because it was the last continent to be explored.

(2.) Difficulties of explorers.

(*a*) No deep openings into the heart of the land as in Europe.

(*b*) No navigable rivers—sand-bars at mouth, cataracts in middle course.

(*c*) Belt of malaria-infested land on the coast.

(*d*) Difficulties of transport. No beast of burden can live for the flies. Hence all goods must be carried by bearers or *pagazis*—slow, expensive, and worrying.

(*e*) Continual warfare between tribes in the centre and south.

(*f*) Fanaticism of Mohammedanism in the north.

(3.) The exploration has been the solution of river problems—for example, Speke, Grant, and Baker on the Nile; Mungo Park on the Niger; Livingstone on the Limpopo, Zambesi, Rovuma, Lualaba; Stanley on the Congo, etc.

4. *History.*—James the First, and Charles the First to 1642.

Chief Points:—James's descent. His theory of divine right and passive obedience.

5. *English.*—Read up the sketch of the history of the language in the *Pupil Teacher's English Notebook*.

6. *Arithmetic.*—Compound interest.

7. *Music.*—The minor scale. Note the three forms.

8. *Elementary Science.*—Prepare the first chapter on chemistry.

9. *French.*—See note above.

CORRESPONDENCE: RULES (as usual).

All communications and queries with regard to the PUPIL TEACHERS' AND SCHOLARSHIP COURSE should be addressed to "Mr. A. T. FLUX, The Bays, Belvedere, Kent."

ANSWER TO CORRESPONDENT.

H. S. Davis.—Edward the Third, in 1337, assumed the title of "King of France," which was adopted by subsequent monarchs, although they had no right to it. It was finally abandoned by George the Third in 1801, after having been retained for over four hundred years.

LOGIC FOR L.L.A. AND LONDON MATRICULATION.

BY T. E. MARGERISON, M.A. (LOND.),
Principal of the Tottenham Pupil Teachers' Centre.

IX.

Analysis of Induction.—The various steps of an inductive process can best be seen by considering a simple example. A child observes that rain follows the gathering of clouds; this leads him to think that the clouds are the cause of the rain; further experience verifies this, and the child arrives at the conclusion "clouds bring rain." This conclusion having been established, the child uses it henceforth as a general proposition which may be the starting-point of deductive reasoning. Thus the four steps in induction are:—

1. Observation or examination of instances.
2. The formation of a hypothesis suggested by the observation.
3. The hypothesis is tested by application to other instances.
4. The verified hypothesis is accepted as a true general proposition.

Observation.—The preliminary examination upon which induction depends is effected by observation of the phenomena concerned. Since accurate induction requires exact observation, it is important that there should be no error at this stage of the process. Observation itself is apparently simple; it is, however, much more complex than it seems, for it involves (1) sensation, and (2) inference from sensation. The many forms of illusion bear witness to the fact that our observation is not always reliable.

A far more fruitful source of wrong inductions is to be found in the range of observation. The things observed must be both *numerous* and *varied*. To generalise hastily from one instance, or a very limited number of instances, is a common mistake in the reasoning of young children. Nor is it sufficient that the examples are numerous; they must also be varied in character, the multiplication of instances of exactly the same kind being of little value.

Observation and Experiment.—Experiment is observation with active interference on the part of the observer, to make the phenomena observed best suit his purpose. This interference considerably extends the process of observation, and increases its value. Mill enumerates its advantages thus:—

1. It enables us to multiply our instances indefinitely. Nature alone would give us very few instances of, say, the contact of two gases whose action one upon the other we wish to examine, but by experiment we are able to bring them together as often as we please.

2. We can isolate the phenomena we are observing, removing circumstances which would tend to hide or destroy the effects to be observed.

3. We can vary the circumstances. "By introducing one well-defined circumstance after another into the experiment, we obtain assurance of the manner in which the phenomenon behaves under an indefinite variety of possible circumstances" (Mill).

4. We can obtain the precise sort of instances we require.

5. It is usually the only means to prove causation, since it enables us to take the supposed cause and try whether it will produce the effect.

The advantages of experiment make it desirable to employ it wherever possible. There are, however, limits to its usefulness. Its main sphere is in the physical sciences; in others, the nature of the subject is sometimes such as almost wholly to exclude the use of experiment. This is the case in Economics; here the reasoning must be largely deductive, or if inductive, must be based on observation alone.

Hypothesis.—This is a term which we use in every-day speech as well as in logic. Ordinarily we mean by it a supposition, the word being derived from the Greek equivalent of the Latin *suppositio*. Mill interprets it logically as "a supposition which we make (either without actual evidence, or on evidence avowedly insufficient) in order to deduce from it conclusions agreeing with real facts." In other words, it is a provisional supposition, which, on further inquiry, may or may not prove to be true. It is the result of the imagination stimulated by the facts observed, and seeking some law which will give unity and order to them.

The formation of hypotheses is the most important and the most difficult part of inductive inquiry. Here it is that the fertile imagination and creative genius of the world's master-minds find scope for the display of their superiority over the ordinary human intellect.

The hypothesis may, on further examination, prove to be untenable owing to its disagreement with known facts. It is then rejected, and some other solution sought. Thus, Kepler is said to have tried and rejected nineteen different hypotheses before arriving at his laws of motion. If the truth of the hypothesis is established, it becomes a *law*; or, if it is a generalisation covering many *laws*, it is called a *theory*.

Mill lays down, as a condition of a *legitimate* or *scientific* hypothesis, that it must be of such a nature as to admit of being proved or disproved by comparison with observed facts.

Explanation.—To explain, in the logical sense, a fact or a law, is to refer it to some other fact or law more general than itself. Thus we explain the falling of an apple by reference to the law of gravitation. It will be noticed that the process is different from what is ordinarily meant by explanation. To explain means, as a rule, to state in familiar and known terms what is at first strange and unknown. But logical explanation may be, and often is, exactly the reverse of this, for the more general law which constitutes the explanation of the particular is frequently the less familiar.

From the nature of logical explanation, it is evident that the process has its limits. We can explain a particular fact by reference to something more general, and then refer in turn to something more general still; but ultimately we reach a law which we cannot explain, inasmuch as there is nothing more general behind it to which it can be referred. On this ground, Mill divides laws or uniformities of nature into two classes: (1) *Ultimate Laws*, which cannot be resolved into other and more general laws; (2) *Derivative Laws*, which can be so resolved.

Perfect and Imperfect Induction.—Induction is said to be *Perfect* when every possible case or instance to which the conclusion can apply has been examined and dealt with in the premises. Thus we can say that all the southern peninsulas of Europe are mountainous, for we know each to be mountainous.

Imperfect Induction, on the other hand, is based on the observation of a part only of the class, the inference from part to whole being justified by assuming, as a fundamental axiom, that the course of nature is uniform.

To Mill, Imperfect Induction is the true form, and he does not recognise Perfect Induction as being induction at all, on the ground that (1) there is no inference from facts known to facts unknown—nothing more is stated in the conclusion than in the premises; (2) the seemingly general proposition is only a number of single propositions written in an abridged form.

Reasoning by Analogy.—This is a process in which we argue that because two things are alike in certain observed respects they are alike in certain other respects. The planet Mars is thought to be like our own planet in diurnal motion, distance from the sun, atmosphere, etc.; it is therefore argued that, like the Earth, it is also inhabited. In Analogy the resemblance is great, but the instances few; in Induction we make the number of instances as many as possible.

In order that reasoning by analogy may be valid, the following conditions should be present:—

1. The resemblances must be great.
2. The differences must be small.
3. Our knowledge of the things compared should be extensive.

At best, however, the process is unreliable. A familiar instance of a wrong conclusion obtained in this way is the confusion of poisonous fungi and mushrooms.

QUESTIONS.

(Students can have their exercises corrected by sending them to the Editor, Logic Course, PRACTICAL TEACHER, and enclosing seven penny stamps.)

1. Explain and illustrate the differences between Deductive and Inductive Reasoning.
2. Distinguish between Perfect and Imperfect Induction.
3. State the advantages of Experiment over Simple Observation.
4. "We tend, in observing, to neglect negative cases, to overlook essential conditions upon which events depend, and to confuse facts with our inferences from them." Discuss and illustrate in detail the above statement.
5. (*a*) State the precise meaning of the terms "genus" and "differentia."
   (*b*) Given the two pairs of terms, "pen" and "pencil," "square" and "rectangle," find for each pair a genus of which the two given terms are species, at the same time assigning a differential mark in the case of each of the terms.
   (*c*) Criticise and amend the following attempts at definition:—
      (1) A horse is a domestic animal.
      (2) A telescope is an instrument for observing the stars.

OUR CERTIFICATE COURSE FOR 1903.

BY GEORGE COLLAR, B.A., B.SC.,
Head-master of the Stockwell Pupil Teachers' School.

TEST QUESTIONS ON LAST MONTH'S WORK.

Theory of Teaching.

1. Describe the proper position of a child whilst writing, and show the ill effects of a bad position. (Cert.)

2. What do you consider to be the characteristics of good writing? How would you get your pupils to write with speed without sacrificing legibility?

3. What aids would you employ in teaching handwriting? Discuss the advantages and disadvantages of "Headline Copy Books."

English Language and Literature.

1. Write a short life of Milton, and give an account of his minor poems.

2. Who were the "Cavalier Poets"? Mention any noteworthy poems written by any of them.

English History.

1. Describe the penal legislation against the Roman Catholics in the reign of Queen Elizabeth. What considerations and events account for it?

2. Survey the exploring and colonising activity of Englishmen in the reign of Queen Elizabeth; and show, by a map or otherwise, with what other European nations they came into competition or conflict as traders or settlers.

3. Give an account of the relations between England and Spain in the reign of James the First, more especially as they affected the part played by England in the Thirty Years' War.

4. Describe Cromwell's Irish campaign, and give an account of the so-called "Cromwellian" settlement of Ireland.

Geography.

1. Give a short account of Morocco, and say what interests different European states have in that country.

2. Give an account of the Suez Canal, and say how it has affected the course of trade.

3. Trace out the proposed "Cape to Cairo" route, and say what advantages would follow the construction of the railway.

Arithmetic.

1. What is meant when stock is said to be (1) at 5 per cent. premium; (2) at 5 per cent. discount; (3) at par?

Stock at 25 per cent. discount pays 5 per cent. on the money invested. What would the same stock at 25 per cent. premium pay on the money invested?

2. A reduction of 20 % in the price of beef would enable a purchaser to obtain 6 lbs. more for a sovereign. What is the reduced price per lb.?

3. Suppose a steam tug travels 10 miles an hour in still water when alone, but draws a barge at 4 miles an hour. It has to take a barge 10 miles up a stream that runs 1 mile an hour, and then return without the barge. How long will it take?

Algebra.

1. If $a : b :: c : d$, prove that $\frac{2a+b}{a-2b} = \frac{2c+d}{c-2d}$.

2. If $\frac{x}{a+b} = \frac{y}{b-c} = \frac{z}{c+a}$, show that $x + z = y$.

3. Show that if $a : b :: c : d$, then

$$\frac{a^3}{b^3} - \frac{a^2c}{b^2d} + \frac{2a}{b} + \frac{ad^2}{bc^2} - \frac{d}{c} - \frac{2c}{d} = 0.$$

Euclid.

1. Show that all straight lines falling across three parallel straight lines are divided proportionately.

2. Show that the rectangle contained by two straight lines is a mean proportional between the squares on the lines.

Elementary Science.

1. Explain clearly the difference between "mass" and "weight." Under what conditions can the weights of bodies be taken as the measures of their masses?

2. Define "density" and "specific gravity." How could you use the specific gravity bottle to find the specific gravity of a sample of dry sand?

NOTES AND SYLLABUS FOR APRIL.

Composition.

Finish the fourth part of Nichol's *English Composition*. Take plenty of exercise in inversion—that is, select numerous passages from both prose and verse, and try the effect of the change of order. In this way you will gain an appreciation of the different effects produced by the various arrangements.

Write essays on the following subjects—

1. "Gather ye rosebuds while ye may."
2. "Sweet is pleasure after pain."
3. "A favourite has no friend."
4. "Where ignorance is bliss,
   'Tis folly to be wise."

English Language and Literature.

Study the third book of the *Golden Treasury*. The first book carried us to the death of Shakespeare, and among the characteristics of the poetry of the period illustrated there, we may note the Italian influence, which showed itself (*a*) in matters of form—the sonnet was introduced from Italy by Sir Thomas Wyatt and the Earl of Surrey; the Spenserian stanza (used in the *Faërie Queene*) was introduced in imitation of Boccaccio's *ottava rima*, or eight-line stanza, the internal arrangement being altered and a twelve-syllable line added at the end; (*b*) in subject-matter—allegory was introduced and developed.

The second book carries us to 1700. During this period the two greatest geniuses were Milton and Dryden. Of the minor poems, the chief are love lyrics. All show a very natural style of writing, though perhaps the sentiment is sometimes forced.

The third book covers the eighteenth century, and is marked by a certain mechanical correctness, and shows painstaking construction rather than the natural flow of genius. The poetry of this period shows the influence of French literature. The views of the best French writers were embodied in Boileau's *Art of Poetry*, which was translated and imitated, and led to the artificial style that marks the period. Very few of the poets who were celebrated in those days because they conformed to the rules laid down are ever read now. Thus the pretty little poem (CLV.) called the "Blind Boy" is almost the only thing by Colley Cibber that is thought worth reading now, although he wrote a good deal, and was, in fact, Poet Laureate. Towards the end of the period there was a tendency to turn to nature. James Thomson, the author of the "Seasons," loved to study nature on Richmond Hill, and we see the effects in his poetry.

Those who have got into the habit of treating each poem on the lines we suggested the other month will quickly get over the ground covered by this book, and will enjoy the work. Note and remember any striking lines; many of them would form suitable topics for composition.

English History.

Study the period from 1660–1800.

The following questions, taken from the Certificate and other public examinations, will show the chief points to attend to:—

1. What hope was there for the Stuart line upon the death of Queen Anne? What attempt was made to realise it? Distinguish the terms *Jacobite*, *Jacobin*, and *Jacobean*.

2. What were the chief extensions of our empire during this period? Describe briefly the circumstances under which each one came to be made.

3. Why did we quarrel with the Dutch in the reign of Charles the Second? Describe the course of the Dutch wars in that reign.

4. What were the chief incidents of the controversy in the reign of Charles the Second as to the succession of the Duke of York?

5. Point out those events in the reign of James the Second that led most directly to the Revolution.

6. State the principal terms of the Union between England and Scotland. Why was the question so urgent in Queen Anne's reign?

7. Enumerate the provisions of the Treaty of Utrecht. What arguments were used for and against the treaty?

8. Give an account, with dates, of (*a*) the battle of Fontenoy, (*b*) the battle of Minden, (*c*) the capture of Quebec.

9. Give a short account of the American War of Independence. What different views were taken by English statesmen as to the authority of the mother country over her colonies?

10. Describe the policy of the younger Pitt. How was it affected by the outbreak of the French Revolution?

11. Give a brief account of (1) the *Letters of Junius*, (2) the Gordon Riots, (3) the Irish Rebellion of 1798.

12. Give a brief account of the work in India of Clive and Warren Hastings.

13. Estimate the influence of the French Revolution (*a*) on English parties, (*b*) on the domestic politics of England.

14. Why were the American colonists successful in the War of Independence?

15. Give the chief provisions of (*a*) the Treaty of Paris of 1763, and (*b*) the Treaty of Versailles of 1783.

Geography.

Prepare the physical geography of North and South America, and the political geography of British North America.

Compare the two divisions. Both roughly triangular; both have the chief elevations near the west coast, thus giving the slope towards the Atlantic and the counterslope towards the Pacific; the Alleghany Mountains correspond with those of Brazil near the east coast. In the northern continent we find a secondary slope, drained by the Yukon and Mackenzie, which has nothing corresponding to it in South America, neither has the latter any rivers of importance running into the Pacific like the Colorado, Columbia, and Fraser rivers.

The elevated parts of North America consist not of one isolated chain, but of a high mass covering nearly half the continent. In the middle of this run the Rockies, and near the Pacific coast the Sierra Madre, the Sierra Nevada, and Cascade Range.

The plains are called Prairies in North America, where they consist mainly of immense stretches of grassy land. In the basin of the Orinoco they are called Llanos, and are subject to great extremes of rain and drought; in the basin of the Amazon the plains are covered with dense forests, and hence are called Selvas, from the Spanish name for a wood or forest; in the valley of the river La Plata the plains are called Pampas, and are mostly covered with grass, although in some parts there are great tracts covered with thistles and such coarse growth; in the north of the Argentine Republic the plain is salt and sandy, and so for the most part desert. The rivers present no great difficulty; sketch-maps of their respective basins should be practised. The lakes—other than the five drained by the St. Lawrence—are not, as a rule, well studied; their position, size, and connections should be known.

Before beginning the political geography of British North America, its physical features may be studied more in detail.

Pay special attention to the trade and means of communication; a full account of the Canadian Pacific Railway should be prepared.

Arithmetic.

Read the chapters on areas and volumes. These will present no difficulty in working, as you are not likely to have any but rectangular surfaces and solids to deal with. You must, however, be careful in stating the rule; do not say, "6 feet multiplied by 3 feet = 18 square feet." You cannot multiply by 3 feet; since multiplication consists in repeating a quantity a certain number of times, the only possible multipliers are abstract numbers. In these calculations the multiplication takes place only between the *numbers*. A similar error is often made in stating the rule for reduction: thus we do not multiply 35s. by 12 to bring the amount to pence, for 35s. × 12 = 420s., not 420d. The rule for finding the area of a rectangle should be stated thus: The *number* of square units in the area of a rectangle is equal to the product of the *numbers* of linear units in the length and breadth. Similarly the rule for reducing shillings to pence should be stated: The *number* of pence in a given sum is 12 times the *number* of shillings (increased by the number of odd pence, if there are any). The student should make a point of going over other rules, in order to make sure of the correct wording.

Questions are often set on methods of statement which are quite incorrect, although common. In 1901 appeared one on the error of joining the remainder from a division sum to the quotient by the sign +.

"Explain and correct the error in the statement—

'66 ÷ 9 = 7 + 3.'"

Since 7 + 3 = 10, the statement actually asserts that 66 divided by 9 gives 10 as the quotient, which is absurd. The correct statement may be made in words without any trouble; but if we wish to keep to figures and signs, we must adopt one of the following:—

$(66 - 3) \div 9 = 7$, $66 = 9 \times 7 + 3$, or $66 - 9 \times 7 = 3$.

The following solutions to questions set in the same paper may be useful, as the questions were not of the usual types given in the text-books:—

Make the following calculations as intelligently as you can—

(1) 9999×9999.

The number of tens of thousands will be the sum of the numbers diminished by 10000—that is, 9999 + 9999 − 10000 = 9998; while the product of the complements—that is, 1 × 1—gives the number of units—namely, 1. Ans. 99980001.

The full explanation of this useful method of multiplying numbers which are near powers of 10 will be found in Appendix A of Christian and Collar's *Arithmetic*.

(2) 241 × £4, 19s. 10d.

As the sum of money is 2d. short of £5, we take 241 times £5 and diminish it by 241 times 2d.; 241 times £5 = £1205, and since 240d. = £1, 2 × 241d. = £2, 0s. 2d.

∴ Ans. = £1202, 19s. 10d.

(3) $\sqrt{28} \times \sqrt{63}$.

Resolving each part into factors, we have—

$\sqrt{2} \times \sqrt{2} \times \sqrt{7} \times \sqrt{7} \times \sqrt{3} \times \sqrt{3} = 2 \times 7 \times 3 = 42$.

(See Christian and Collar, page 72.)

(4) A sum is invested at compound interest, payable annually. The interest in two successive years was £112, 10s. and £115, 6s. 3d. Find the rate of interest and the value of the principal at the beginning of the first of these years.

As the principal for the second year exceeds the principal for the first year by the interest which accrues during the first year, it follows that the increase in the interest must be the interest on the first year's interest. Thus the question tells us that the interest on £112, 10s. for one year is (£115, 6s. 3d. − £112, 10s.), or £2, 16s. 3d.

∴ The interest on £100 for one year is $\frac{£100}{£112\frac{1}{2}}$ of £2, 16s. 3d.

—that is, $\frac{8}{9}$ of £2, 16s. 3d. = £2, 10s.

First Ans. = 2½ per cent. per annum.

The sum on which the interest for one year at 2½ per cent. is £112, 10s. will obviously be

$$\frac{£112\frac{1}{2}}{£2\frac{1}{2}} \text{ of } 100; \quad \frac{225}{5} \text{ of } £100 = £4500.$$

Algebra.

Study the chapter on proportion, and after learning the proofs of the simpler theorems given in the book, apply the same methods to show that if $a : b :: c : d$, then any ratio which involves a and b in every term is equal to the ratio derived from it by substituting c for a, and d for b—for example,

$$\frac{a^3 - 2a^2b + b^3}{ab + 3b^2} = \frac{c^3 - 3c^2d + d^2}{cd + 3d^2}.$$

We have already referred to the use of the principles of proportion in solving equations. We now give another example, which will be appreciated the more after a careful study of those principles.

$$\text{Solve } \frac{x^2 - x + 2}{x^2 + x - 2} = \frac{x^2 + x + 1}{x^2 - x - 1}.$$

By *componendo* and *dividendo*

$$\frac{2x^2}{-2(x - 2)} = \frac{2x^2}{2(x + 1)};$$

that is,

$$\frac{x^2}{2 - x} = \frac{x^2}{x + 1}.$$

This is evidently true if $x = 0$; but if x is not equal to 0, divide both sides by x^2, then

$$\frac{1}{2 - x} = \frac{1}{x + 1}.$$

$\therefore x + 1 = 2 - x$; or $2x = 1$, and $x = \frac{1}{2}$.

Euclid.

Revise to the end of Book III.

The following are typical of the riders that have been set:—

1. ABCD is a rectangle. P is a variable point such that the line joining the feet of the perpendiculars from P on AB, AD, is parallel to the line joining the feet of the perpendiculars from P on CB, CD. Show that P lies on the diagonal AC of the rectangle.

2. O is a fixed point outside a circle, and PQ a variable chord of the circle, such that the sum of the squares on OP and OQ is constant. Show that the middle point of PQ must be on a certain straight line perpendicular to the line joining O to the centre of the circle.

3. From the angles B and C of a triangle ABC straight lines are drawn at right angles to AB and AC, meeting the opposite sides in P and Q respectively. Show that B, C, P, Q lie on a circle, and that the straight lines joining the middle point PQ to B and C are radii of the circle.

4. Show how to construct a right-angled triangle, having given the hypotenuse and the difference of the two sides.

Elementary Science.

Study such portions of heat and light as are given in the syllabus.

Distinction between Heat and Temperature.—It is often said that a thermometer measures heat, but it will easily be seen that a thermometer alone cannot measure heat. Take two quarts of water and set them in two vessels over a fire until their temperatures are the same—say 90°. The thermometer gives the same reading in each, and we may suppose that each contains the same amount of heat. Then on pouring the contents into another vessel, evidently the half-gallon of water contains twice as much heat as each of the quarts separately. But apply the thermometer, and it gives the same reading as in each of the separate quarts. Again, put some water on the fire and let it boil. The temperature rises to 100° C., and then, when the water boils, remains stationary. Evidently the quantity of heat imparted to the vessel increases the longer it stays on the fire, but yet the temperature of the water remains at 100° C., which is also the temperature of the steam given off. These two experiments show conclusively that temperature and heat are not the same. What, then, is each? Heat is usually defined as a form of motion, and many arguments can be adduced to show that this is the case, and, moreover, that the greater the quantity of heat, the greater is the amount of the motion that takes place. Heat is, however, most easily recognised by its effects on bodies, and among these are expansion and change of physical state—for example, from solid to liquid, or from liquid to gaseous condition. These effects may be used in measuring heat, for the quantity of heat required to melt a mass of ice is proportional to the mass of the ice melted. Temperature, however, is a quality belonging to all bodies, and is relative only, so that we may say that the temperature of one body is higher or lower than that of another. It may be defined as that property of a body in virtue of which it will receive heat from, or give heat to, another body with which it is connected, and the body which gives out heat is said to be at the higher temperature. Temperature is only one of the elements required in the measurement of heat. It is found that the same quantity of heat which will cause a rise of temperature of 10° in one pound of water, will cause a rise of 5° in that of half a pound of water, or of 2° in that of a fifth of a pound. Hence we find that the quantity of heat is proportional to the rise of temperature caused, and to the mass of the body in which the rise takes place. We define a unit of heat as that amount of heat which will raise the temperature of one pound of water through one degree.

Transmission of Heat.—Heat may be transferred from one body to another in one of three ways:—

(*a*) It may flow from one body to another with which it is in contact, neither body moving from its place during the process. This is called *conduction*.

(*b*) It may pass from the source of heat into a body which becomes heated, and then *travel* to the colder body, to which it imparts the heat it has received. This is called *convection*. It is in this way that the heat of the furnace is conveyed to the rooms in the case of a building heated by hot-water pipes, and in using of a "box-iron" or a "flat-iron" heat is conveyed from the fire to the clothes. It must be noted that convection consists of three stages, the first and last of which are cases of conduction.

(*c*) Heat may travel in rays from the source of heat to the object heated, passing through a medium which does not become heated and does not travel. This is called *radiation*, and is the method by which the sun warms the earth and a fire warms persons seated in front of it.

Note cases in which heat may be transformed into other forms of energy. In a locomotive the heat of the furnace is transformed into the kinetic energy (or energy of motion) of the train, which again is partly reconverted into heat by the friction on the bearings of the wheels and between the wheels and rails. Again, the heat of a furnace may move an engine which turns a dynamo, and thus the heat may be converted into an electric current, the electric energy again being converted into light and heat in an electric lamp, or into motion in an electro-motor. The exact relation was discovered by Dr. Joule, who found that 772 units of mechanical work produced one unit of heat. This number is very important to remember, and is called Joule's equivalent.

Space will not enable us to deal with "Reflection and refraction of light, Decomposition of white light," but the student will find these matters ably dealt with in Cartwright's *Physiography*.

Next month we shall give some notes on the biological section.

Theory of Teaching.

Considerable attention is now being given to the teaching of drill in schools, and it is quite to be expected that questions will be set on this subject in the next Certificate Examination. The leading systems of physical exercises should therefore be studied, particularly the "Model Course" issued by the Board of Education. The objects aimed at in the system as a whole, as well as in its individual movements, should be carefully noted. Of course, every system aims at the co-ordination of muscular movement, and at the production of habits of obedience.

The other subject for this month's study is the teaching of music in school. The respective claims of the two notations should be carefully summarised, and we think that our readers will agree that the arguments in favour of each are so strong that both should be taught. This seems to be the view now held by the Board of Education, and the student will do well to consider how the two may be worked together, or how the tonic sol-fa system may be used as an introduction to the staff notation.

The student is required to recognise the "onset of acute diseases;" and as certain diseases are common among children, we give the following notes on the symptoms which mark their appearance.

The first indication of one of these diseases is usually a headache or a sore throat (but, of course, these may occur independently of any other ailment), and the child is often seen to shiver and turn sick. Most of these complaints are marked by feverishness and by rash on the skin, but this does not generally show itself until two or three days after the child is taken ill. A teacher should not detain in school a child who is obviously ill; and if the rash and feverishness are noticeable, the child should be sent home in charge of some one, who should urge upon the parents the necessity of calling in the doctor. Children in a robust state of health often show no preliminary symptoms, and the special symptoms of the disease are the first indication that anything is wrong. The following are the usual symptoms of the diseases with which we are dealing:—

1. *Scarlatina, or Scarlet Fever.*—The child shivers and feels ill, his throat is sore, and after twenty-four hours a rash appears on his chest, which generally extends over the rest of the body. The throat is red and the tongue furred, and the skin is either covered with a number of red blotches, or is uniformly of the colour which gives its name to the disease. In the last stage the skin peels, and this is the most infectious time; and although the child may feel quite well, he should not be allowed to mix with others until the peeling is complete.

2. *Diphtheria.*—This terrible disease has few outward signs: the throat feels sore, and is marked with white patches.

3. *Measles.*—The earliest symptoms are those of a severe cold—shivering, sneezing, sore throat, and running at the nose and eyes. About the third day the eruption appears in the form of red spots on the face, chest, and limbs, these spots often taking the form of a crescent. This disease is very infectious right from the beginning.

4. *Rotheln, or German Measles.*—The symptoms of this closely resemble the above; the skin is sometimes redder, and the indications of a severe cold do not always mark its commencement.

5. *Small-pox.*—This is first indicated by headache, vomiting, shivering, and pains in the limbs and back. In two days a pimply eruption appears on the face, chest, and other parts of the body. The pimples become filled with water, then with matter, and afterwards scab over. The child is not free from infection so long as any scabs remain. The number of the pimples may be taken as a measure of the severity of the disease; in mild cases very few are present.

6. *Chicken-pox.*—The symptoms resemble those of small-pox, but are milder.

7. *Whooping-cough.*—The child has severe fits of coughing, which often continue till he is quite out of breath. The name is taken from a whooping or crowing noise which is heard when the child draws his breath after each fit of coughing.

8. *Mumps.*—The child feels ill and feverish, and complains of pains in the side of the head and neck. Very soon the face and neck begin to swell.

9. *Typhus Fever.*—Now, fortunately, of very rare occurrence; is marked by headache, shivering, and general illness. In a few days the abdomen, and often other parts of the body, assume a mottled appearance.

10. *Diarrhœa.*—This should lead the teacher to see that the school keeper is punctual in his duties of cleansing the water-closets.

11. *Ringworm.*—A red spot appears, which grows larger. This is most difficult to cure when it occurs in the head.

Children suffering from small-pox, scarlet fever, or diphtheria must be excluded from school until the doctor certifies that they are free from infection. Those suffering from measles or mumps should be excluded for one month, those suffering from chicken-pox for two or three weeks, those suffering from whooping-cough as long as the cough exists.

OUR COMPETITION PAGE

OUR FRENCH PRIZE COMPETITION.

Prize Editor—W. T. THOMPSON, B.A. (LOND.), *French and German Honours.*

Important to Scholarship, Certificate, and London Matriculation Students.

WE should like to specially direct the attention of our readers to the fact that the Board of Education, in the Syllabuses for the Scholarship and Certificate Examinations 1901 and 1902, requires "no set books" for French and German. Students preparing for these examinations, as well as students for London Matriculation, cannot do better than attempt month by month the pieces set for translation here. They are from the best authors, and of varied character. A competitor who does not gain a prize can derive considerable benefit from the exercise. A study of the successful competitor's translation, and of our remarks, will help him to see where he might have done better. If desired, his paper can be returned (fully corrected) by enclosing six stamps together with a stamped and addressed envelope. Corrected papers cannot be posted until after publication of the journal.—ED.

RULES.

1. All translations should be **posted not later than April 8,** and addressed:—*Prize Editor*, Office of the PRACTICAL TEACHER, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.

ALTERATION IN RULE 3.

3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

FRENCH PRIZE COMPETITION.

A Prize of One Guinea will be given for the best translation into English of the following extract:—

Je n'ai jamais compris la nuance qui permet de crier bien haut: "Voilà un beau cheval! Voilà une rose admirable!" et qui interdit sévèrement la même remarque sur un visage à la confection duquel on n'a pas pourtant pris plus de part, tout simplement parce qu'il est à vous. Il est reçu, et même assez goûté, d'entendre quelqu'un parler de son nez ou déclarer que ses yeux sont louches; mais avouer tout bêtement que le bon Dieu les a placés droits.....horreur! c'est une chose sur laquelle chacun a dû garder la plus candide ignorance, comme si le plus petit coin de miroir ou la moindre source vive ne vous l'apprenait pas sans le secours de personne!.....On se penche, on regarde, et on voit joli.....Est-ce un crime, et faut-il troubler l'eau pour que ses rides vous tordent le visage?.....Les cerfs et les biches qui venaient boire cet été pendant que je rêvais à petit bruit près d'eux faisaient ainsi. Après avoir fini, ils restaient là encore un instant, sans bouger, avec la tête inclinée et leurs yeux doux fixés sur leur image; puis ils s'en allaient d'un bond, tout naïvement heureux de savoir leur pelage d'un brun si charment et leurs grands bois si bien plantés. Après les biches, c'était moi qui me penchais, et je voyais tout ce qu'elles avaient vu sur le même fond bleu, avec les mêmes coups de nuage qui passaient brusquement en taches blanches ou grises, et quand je m'en allais ensuite, d'un bond, toujours comme elles, il ne m'était point désagréable non plus de songer à mon pelage.

JEANNE SCHULTZ.

The prize-winner of the February French Competition (Kyleside) is Miss R. F. Forbes, 78 Mitcham Lane, Streatham, S.W.

RESULT OF THE MARCH COMPETITION.

The prize is awarded to "Gentiane." (Will "Gentiane" kindly forward name and address?)

First Class.—Ethik, Dewhurst, Snowflake, C.E.M., Paradox, Aiphos, Saint-Cloud, Traduzco, Français, Alectrice, Anacreon, Chemineau, Kyleside, Nina, Regret, Irénée, Retlaw Rettop, Ince, X, Marwenne, Rustica, Frena, Kettering, M.F.E., Tyro, M.G.I., St. Fittick, Lennox, Clansman, C.B., Fernwood, Wessex, Sheila, Débutante, Red Ant, Greta, E. C. Redvers, Wakefield, G.M.L., H.M., Fourchévif, S.A.M., Scot, Lilla, Norah, Bulldog, Justine, Rémois, Day Dawn, Helen, Tregun, La Printanière, A. Bhoidheach, Trellis, Niza, Bever, Ardencraig, M², Katharine, Moffat Hartfell, The Muir, Strophe, Nellie, Editha, Mountaineer, Cedric, Una, Orion, Zenda, Bluebag, Alcar, Agaznog, Claren, F.W.S.G., Plain Mary, M.L.A., Elith, Dean Castle, Tancredi, Frog, Ephesian, Fingal, Gladiator, Pons Asinorum, Mathetes, A.R., Tonbryn, Cholacaca, Kit, Didy, Radnor, Dynevorian, Veronica, Bonnie Briar, Major Boxer, Carma, Orchestra, Elgin, Medusa, Ambrosia, Désespoir.

Second Class.—Gosforth, Anna, Central, Perseus, Rodney, Clematis, R.E., Jan, Croissant, Belinda, Bruce's Spider, Cinders, Meddlesome Matty, Xavier, Gabrielle, A Celt, Dot, Jem, Lonsdale, D'Artagnan, Tarantella, Ley Bent, Qui vive, Une écolière, Marcus, Currer Bell, Kismet, Porthos, Jopedi II., Bourne, Tregudda, Iota, C.H.M.Y., Royal Hibernian, Aberdale, Nil Desperandum, Une anglaise, G.T.F., Alma, Aid, Petite amie, Bachelor, Pontypridd, Cymraes o Gymru, Greville, Stulta, March, Letty, Evangeline, Barker, Le printemps, Harnham, Excelsior, Leeby, Hovan, A.M.D.G., C.B., Gorgon, Wartree, Lizzie Booth, Portmarnock, Jessica, Pas de Calais, Banbury Cakes, Good Luck, Carrots, Rita, Nil Desperandum (Langley), Adelaide, Somebody.

Third Class.—Nil Desperandum (Portsmouth), Chaste, Belgrave, Cassandra, Geisha.

Report.

There is a very great inequality of merit in the papers of this month. The mistakes made principally occurred in the opening lines of the piece. Many competitors failed to notice that the verbs relating to the French possession of Alsace refer to past time. Hardly any one translated *Je dirai* in the proper sense in which it is used of "I mean," "I intend to say;" and nearly all, the successful competitor included, translated *choquer* by *shock*. *Choquer* means "to be repugnant to one," "to grate on one's feelings."

Prize Translation.

"Nonsense!" cried Fincken. "Alsace belonged to Germany naturally; it has gone back to her; she is only making her repossession of it secure. Who would not do as much?" "Why, France," retorted Oberlé, "and that is why we loved her. She may have once taken possession of the land, but she never did violence to the soul of its people. We belonged to her by right of love." The baron shrugged his shoulders. "Why not go back to her then?" John almost exclaimed, "If only we could." The servants had ceased passing the cakes to listen. He went on: "To me, therefore, your scheme is bad in itself, for it crushes a people's conscience; but I also think it a mistake from a German point of view." "Delightful!" put in Mme. Knäffle, in her falsetto voice. "You should have every interest in preserving all that is left in us of originality and independence of thought. To do this would be to give a useful example to Germany." "Thanks," said a voice. "And one which would be more and more useful," insisted the young fellow; "for I was brought up in Germany, and am quite sure of what I advance. What has struck and shocked me most is the lack of individuality in Germans, their growing forgetfulness of liberty, their self-effacement before the power of—" "Take care, young man," broke in quickly Councillor Brausig.—"I will say, Councillor, before the power of Prussia, which destroys consciences, and only allows the right of living to three classes of men, classes which she has modelled from their infancy—namely, ratepayers, officials, and soldiers."

GENTIANE.

OUR SCIENCE SECTION

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PHYSIOGRAPHY.

(ADVANCED AND HONOURS.)

The Red Spot on Jupiter.—The planet Jupiter, with its mysterious vapoury markings moving at varying rates in a number of different parallel currents, has always been an object of great interest. Its huge red spot, computed to be 7,000 miles across, was first noticed some twenty-four years ago. It rapidly increased in definition and depth of colouring, but later on it faded, till, in 1892, it had almost disappeared. It then had a constantly-increasing retardation of motion; but Mr. Denning, writing to *Nature*, states that he has recently noticed that it has now a very pronounced acceleration of motion. In 1901 its period of rotation began to decline, and this acceleration of motion has been intensified during the past summer. About the same time there was an outbreak of "a large, irregular or multiple marking of a dusky hue" in the same latitude of the planet, having a rotation period corresponding to that of the south temperate current. The red spot has always been situated in a stream flowing with a much greater velocity than that of its own motion, which makes its presence very difficult of explanation. One of the most remarkable episodes of its career was when, in 1890, Mr. Stanley Williams noted a dark spot moving along the same parallel at a greater rate. This was watched with the greatest interest, to see what would happen when it encountered the great red spot; but it was a surprise to all observers when it was seen to evade the latter by skirting round its southern edge.—*Illustrated Scientific News.*

Royal Meteorological Society.—Mr. E. Mawley presented his report on the phenological observations for 1902. In all parts of the British Isles the phenological year ending November 30, 1902, was for the most part cold and sunless. Rain fell at unusually frequent intervals, so that, although the total quantity proved deficient, there at no time occurred any period of drought. Wild plants were everywhere behind their mean dates in coming into flower, but the departures from the average were, as a rule, slight, until about the middle of May. After that time, until the end of the flowering season, the dates of blossoming were later than in any other year since the present series of records was instituted, in 1891. The swallow, cuckoo, and nightingale were a few days earlier than usual in making their appearance. The most remarkable feature as regards the weather and its effect on vegetation was the way in which it favoured the growth of all farm crops except potatoes and hops. For it is seldom in the same year that the yields of wheat, barley, oats, beans, peas, turnips, mangolds, and grass are alike abundant, even in a single district, much less in all parts of the kingdom, as was the case in 1902. On the other hand, all the fruit crops were more or less deficient, with the exception of strawberries, which yielded well, but were, like most other fruits, lacking in flavour.

Proper Motion of the Sun compared with Stellar Velocities.—In a paper communicated to Section A of the American Association for the Advancement of Science, Professors Frost and Adams, of Yerkes Observatory, give the results they have obtained, using the Bruce spectroscope, of the radial velocities of twenty stars having spectra of the Orion type. The table of radial velocities included in the paper shows that of all the stars considered, those between 3 hours and 7 hours R.A. have a positive motion—that is, they are receding; whilst those in the opposite region of the heavens, 16 hours to 20 hours R.A., have a negative motion—that is, they are approaching. This difference is chiefly due to the velocity of the proper motion of the sun; and if the amount of this motion be subtracted from the values obtained, the remaining proper motions of the stars are very small, scarcely any of them having such great velocities as that of the sun.

Ground Temperature Observations.—We have received a paper by Father Algué, S.J., director of the Philippine Weather Bureau, on ground temperature observations at Manila. Underground temperatures have been regularly observed in Manila since the year 1895, with four thermometers placed 59·06 in., 29·53 in., 17·72 in., and 13·78 in. below the surface of the ground, and more recently three more have been added at depths of 9·84 in., 19·68 in., and 39·38 in. Discussing the temperatures at 19·68 in. and 39·38 in. in detail, Father Algué finds that at the former depth the minimum of the year falls in December and the maximum in May; the minimum of the day occurs at 6 a.m., a secondary minimum at noon, and the maximum about 10 a.m. The daily range varies from about 6° C. in April to about 3° C. in the coldest months of the year; temperature is nearly constant from midnight to 6 a.m. At a depth of 39·38 in. the minimum temperature usually falls in December, and the maximum in May; a large oscillation takes place from about 6 a.m. to 10 a.m., followed by a slight descent until 11 a.m.; from January to May temperature remains low to about 4 p.m., rises slightly at 6 p.m., and then remains steady all night until 6 a.m.

Why the Air is Electrified.—A new and interesting theory as to the origin of the appearance of the higher atmosphere, which is popularly styled the "blue sky," has been advanced by M. Spring, a well-known scientist of Liége. M. Spring has carried out a number of experiments with luminous rays under almost all conceivable conditions, directing them into agitated solutions, and into a glass tube containing pseudo-solutions such as chloride of aluminium of absolute limpidity; but although he could obtain red, yellow, violet, etc., under no circumstances could he obtain blue, until by the use of electricity he secured a perfectly pure atmosphere in which blue was clearly discernible. M. Spring therefore concludes that the blue of the sky is purely electrical in origin, and is an essential quality of the air.

Meteorological Ballooning.—The preliminary accounts of the international balloon ascents of December 4, published by Dr. Hergesell, show that France, Germany, Austria, Italy, Russia, and the United States (Blue Hill) took part in the experiments. Both manned and unmanned balloons and kites were used; the highest altitudes attained were:—Itteville (near Paris), 14,823 metres, lowest temperature −52·9° C., temperature on the ground −4·8°; Strassburg, 16,500 metres, minimum temperature −65·2°, on the ground −7·8°; Berlin, 14,465 metres, temperature −35°, on the ground −11·5°, the lowest temperature was −46·7° at an altitude of 9,670 metres; Pavlovsk, 17,700 metres, the lowest temperature was recorded at 11,220 metres, −63·5°, on the ground −20·7°; at Blue Hill the wind was not strong enough to raise the kite higher than 1,100 metres; an inversion of temperature occurred at the height of 1,000 metres. The European ascents were made in an area of high barometric pressure.

Composition of Meteorites.—Professor Liversidge, F.R.S., recently read a paper on the presence of platinum and iridium metals in meteorites. The author described the occurrence of gold in meteorites; in certain cases the gold is accompanied by one or more of the platinum and iridium metals. The Boogaldi meteorite contains both gold and one or more of the platinum metals; these metals do not appear to be uniformly diffused through the meteorite, for some parts apparently contain a much larger proportion than others. The amount of the platinum metals in the Boogaldi meteorite is comparatively large, being at the rate of several ounces per ton. T. C.

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CHEMISTRY.

(ADVANCED AND HONOURS.)

BY T. CARTWRIGHT, B.A., B.SC.

Distillation of Chlorine Water, by A. Richardson.—Pickering (*Trans.* 1870, xxxvii. 139) has shown that when aqueous solutions of chlorine are heated in an open vessel, a residue containing hydrochloric acid remains behind after all the active chlorine has been expelled; and the present work was undertaken in order to find out whether the escaping chlorine was present wholly in a free state, or mixed with one of its oxy-acids.

When chlorine water was heated in a retort, the distillate, which was obtained below 100°, contained free chlorine, the gas being readily displaced by a current of air. The solution in the retort, however, still contained active chlorine; for it liberated iodine from potassium iodide, bleached indigo solution immediately, and gave, on shaking with mercury, a brownish-yellow deposit resembling that obtained with hypochlorous acid. This result proved to be independent of the action of light, and was not influenced by further purification of the chlorine.

Quantitative estimations of the chlorine in the aspirated distillate gave, for the active chlorine estimated iodometrically, values double those obtained for the total chlorine found with silver nitrate after treatment with sulphur dioxide. These results show that the active chlorine is present as hypochlorous acid.

Distillation of chlorine water in a current of chlorine gas showed that the hydrochloric acid formed in the residual solution was equivalent to the hypochlorous acid found in the distillate, indicating that a portion of the chlorine reacts with the water according to the equation $Cl_2 + H_2O = HCl + HClO$.

Again, when aliquot parts of the distillate and residue obtained on distilling chlorine water were mixed, a solution having all the properties of the original chlorine water was reproduced. It would appear, therefore, that hydrochloric and hypochlorous acids are separated during distillation as the products of the partial change of chlorine water.

When chlorine water was heated in a flask provided with a reflux condenser, so that the distillate returned to the original solution, the ratio of active to total chlorine found was that required for a solution of free chlorine, showing that the solution is stable when the separation of the two acids is prevented.

A further study of the change showed that the amount of hypochlorous acid passing over decreased with the increase in strength of the hydrochloric acid formed in the solution. With very dilute solutions of chlorine water, the whole of the free halogen employed entered into reaction with the solvent, the oxy-acid only having been found in the distillate.

Finally, distillation of very dilute chlorine water in a vacuum at the ordinary temperature gave a distillate containing the oxy-acid, showing that the reaction occurs at the ordinary temperature as well as at the boiling point.

A New Vapour Density Apparatus, by John S. Lumsden.—This apparatus is based on the principle that the molecular weights of all substances in the state of gas, when occupying the same volume and at the same temperature, exert the same pressure. The pressure produced at a given temperature by the molecular weight in milligrammes is either found experimentally by vaporising a substance of known molecular weight, or calculated from the dimensions of the apparatus; then, from the pressure produced by vaporising a weighed quantity of the substance the molecular weight of which is required, the weight in milligrammes which would produce the milligramme molecular pressure is found. This is taken as the molecular weight.

No barometric reading is necessary; and when the constant of the apparatus has been found and the substance weighed, the experiment is completed in two minutes, and the calculation of the result may be made in another two minutes.

By slightly modifying the arrangement of the apparatus, the substance may be vaporised under diminished pressure or in an inert gas, and the experiment may be performed at any temperature. The instrument, which is quite as accurate as the Victor Meyer apparatus, is, owing to its simplicity, well adapted for general laboratory work.

The Existence of Electrolytic Superoxides of Lead, Nickel, and Bismuth (A. Hollard).—It has always been admitted that the lead peroxide which is deposited at the anode of a saline lead solution through which a current passes is lead dioxide (PbO_2). Contrary to this assertion, the author finds—(1) that the analytic factor 0·866 is too great, and that, in addition to the dioxide PbO_2, higher oxides are deposited at the anode; (2) that the proportion of these higher oxides is greater as the concentration of the lead in the bath is decreased. Nickel and bismuth also form similar oxides when their solutions are subjected to electrolysis.

Equilibrium produced between Copper, Silicon, and Manganese. Manganese Silicide, Si_2Mn (P. Lebeau).—An investigation of the action of a great number of metals on copper silicide leads the author to the conclusion that certain of them—such as silver, tin, zinc, and aluminium—have a real affinity for copper, forming an alloy with this metal, and causing the silicon to crystallise out. Other metals, on the contrary, react on molten copper silicide, uniting with the silicon to form a definite silicide, and giving at the same time compounds with silicon and copper. To investigate the equilibrium of these systems, the author prepares a series of metallic masses containing copper, silicon, and another metal in definite proportions. The experiments led to the preparation of three definite silicides of manganese—$SiMn_2$, SiMn, and Si_2Mn.

Magnalium: a Most Promising Alloy.—When first aluminium was introduced as what we may call a commercial metal, a great deal was said in its favour as being so light, strong, and untarnishable. But it was soon found that it was not all that could be desired, since there were practical difficulties in working it. Various alloys were tried, but none of them proved to be much of an improvement on the pure metal, without much increasing the weight, until the alloy magnalium was discovered. This is obtained by combining a certain proportion of magnesium (from 2 to 30 per cent.) with the aluminium. The result is a white metal like silver, capable of taking a high polish, which does not oxidise on exposure, being in this respect only surpassed by gold, silver, and platinum. It is actually lighter than pure aluminium, the specific gravity varying, according to the proportions of the metals, from 2·40 to 2·57, while that of aluminium is from 2·56 to 2·68, and magnesium, 1·7. The harder the alloy, which practically means the greater the proportion of magnesium, the lighter it is. The melting point of the alloy is between 640° and 676° C. (or slightly higher than that of the pure metal).

It is a good conductor of heat and of electricity. As regards strength, its tenacity is nearly as good as wrought iron, being about 16 tons to the square inch. This alloy cuts and files well, and forges readily. It can be welded, and may be soldered with a special solder. It is most suitable for casting, and is formed into rods, sheets, tubes, and wire. Excellent screws can be cut in this material, so that it is particularly suitable for making telescopes and field-glasses of. Owing to its lightness, it should prove of great value to the experimenter with flying-machines, and, if capable of withstanding the action of salt water, should be invaluable for yacht and boat fittings. As regards price, small quantities can be obtained at from 3s. a pound for ingots to 4s. for sheets and rods, tubes and wire being more. This is far cheaper than aluminium was ten years ago.—*Illustrated Scientific News.*

Action of Hydrochloric, Hydrobromic, and Hydrofluoric Acids on Monopersulphuric Acid (E. Wedekind).—During the preparation of Caro's reagent, $SO_2\langle^{O-OH}_{OH}$, by mixing sulphuric acid with ordinary peroxide of hydrogen which contains a certain quantity of hydrochloric acid, we often observe the odour of chlorine very distinctly, which can only result from the oxidation of the hydrochloric acid. By means of M. Baeyer's dry reagent, obtained by the action of concentrated sulphuric acid on persulphate of potassium, we can oxidise hydrochloric acid in the cold, and thus obtain chlorine. A concentrated solution of hydrobromic acid behaves in a similar manner, giving off bromine fumes. With the hydracids in the gaseous state the reaction is not so violent, but it is very characteristic. Since monopersulphuric acid oxidises the hydracids, and the water formed during the reaction can be absorbed by sulphuric acid, it was natural to try the action of this reagent on hydrofluoric acid. Our experiments showed that sulphate of potash is fairly stable in contact with fluorine in the cold, but decomposes when heat is applied. One series of experiments showed us that anhydrous hydrofluoric acid is perfectly stable in the presence of monopersulphuric acid; there is no hope, therefore, of preparing fluorine by this method. If we add anhydrous hydrofluoric acid to the solid reagent in a platinum crucible, no reaction takes place; after about ten minutes, gas is given off by the evaporation of the hydracid. If we pass a current of hydrofluoric acid gas through a platinum tube containing the solid reagent, the gas escaping from the tube will not inflame crystallised silicon. The author also gives other experiments showing that there is no action with hydrofluoric acid similar to that with hydrochloric and hydrobromic acids.

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ELECTRICITY AND MAGNETISM.

(ADVANCED AND HONOURS STAGES.)

BY EDWIN EDSER, A.R.C.S., F.PH.S.

Motor Generators.—The electromotive force of a dynamo depends, as previously explained, on the speed at which the dynamo is driven, the radius of the armature, the field in the air gap, the number of conductors under a single pole, and the length of each of these conductors. If there are N conductors under a pole, each of length l, while the radius of the armature is equal to r, and the latter is driven at a speed of n turns per minute (or $\frac{n}{60}$ turns per second), then the E.M.F. of the dynamo E will be given by the equation

$$E = \frac{2\pi n}{60} rNlB,$$

where B is the field in the air gap, in C.G.S. lines per square centimetre. It follows that a dynamo may be designed to generate any required E.M.F. The maximum current which may be taken from the machine will depend on the resistance of the armature—a large current requiring a small armature resistance, so that the drop within the armature shall not be excessive.

If two dynamos are constructed on identical lines, except that while one has N_1 conductors per pole, the other has N_2 conductors per pole, then the E.M.F.'s generated will be in the ratio N_1/N_2.

Now, it is immaterial whether the dynamo be driven by a steam-engine, a gas-engine, or any other source of power; the one thing which is of importance, so far as the generation of E.M.F. is concerned, is the speed at which it is driven. Thus the dynamo may be driven by an electro motor, either directly—both motor and dynamo being keyed to a common shaft—or indirectly, by the aid of speed pulleys and belting. In the latter case the motor and dynamo may run at different speeds; in the former case both must, of course, run at the same speed. A dynamo and motor keyed to a common shaft is termed a *motor generator*, and can be used for various purposes in connection with electric transmission of energy.

A motor generator is represented diagrammatically in Fig. 1. The two armatures are shown keyed to a common shaft, each being provided with a separate commutator and pair of brushes. The field magnets are represented in section by N, S, N′S′. Each machine may be wound in the manner suited for its requirements, either as a shunt or series machine. The speed of the motor is determined by the circumstance that it must generate a back E.M.F. equal to the volts of supply; if it were driven as a dynamo at the same speed, it would generate a numerically equal direct E.M.F. Let us suppose for a moment that both machines are shunt wound and similar, except for the number of conductors wound on the armature. In Fig. 1,

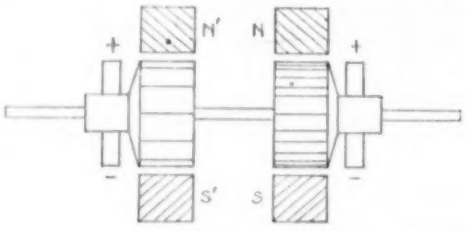

Fig. 1.

the right-hand machine is shown with twice as many conductors as the left-hand machine, and therefore, if both were driven as dynamos at the same speed, the fields in the air gaps being equal, the right-hand machine would generate an E.M.F. twice as high as that of the left-hand machine. If, now, the right-hand machine is connected to the supply mains as a motor, it will run at a certain definite speed, equal to that at which it would have to be driven as a dynamo in order to generate an E.M.F. equal to the volts of supply. The left-hand machine will, of course, rotate at the same speed; and since B, l, and r are equal in both machines, the only difference being in the value of N, it follows that the left-hand machine will generate an E.M.F. equal to half the volts of supply. By varying the windings of the two armatures, the left-hand machine could be designed to supply current at any desired voltage, either greater than, equal to, or less than the voltage of supply. The current which can be economically taken from the generator will depend on the sectional area of the armature conductors; but in any case the watts supplied by the generator can never exceed those delivered to the motor. The latter condition is an obvious consequence of the law of conservation of energy. In practice some energy is always wasted, so that the generator supplies less energy per second than is delivered to the motor. Thus if e is the percentage efficiency of the combination, E being the volts of supply, and C being the current absorbed by the motor—while E′ is the E.M.F. of the generator, C′ being the current supplied by the same—then

$$E'C' = \frac{eEC}{100}.$$

Large motor generators may be constructed with an efficiency of 90 per cent. or more, and by their aid electrical energy can be transformed from high to low voltage, or *vice versâ*, with a loss not exceeding 10 per cent. For instance, the advantage of a high voltage in the distribution of energy to great distances has already been dwelt on; but it has been found unsafe to directly use a higher voltage than 250 volts for domestic lighting purposes. This difficulty can be overcome by distributing energy at, say, 500 volts, and then transforming the energy, by means of a motor generator, to 250 volts at a sub-station near the place where the energy is required.

Boosters.—The term "booster" is used to designate a motor generator when used to *boost* (or hoist) up the voltage in a circuit, thus compensating the drop which must occur in the conducting mains. Boosters may take several forms, of which two will here be described. Fig. 2 represents diagrammatically

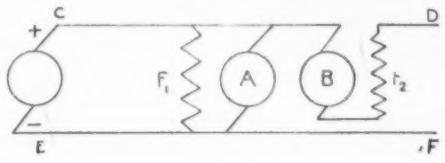

Fig. 2.

a boosting arrangement for a two-wire circuit. A and B represent the armatures of the motor and generator, which are keyed to a common shaft, and supplied with separate field magnets and magnet windings. The motor A is shunt wound, its field coils, represented diagrammatically by F_1, being connected across the supply mains CD and EF. The motor A will thus run at an approximately constant speed. The generator B is provided with series-wound magnets; the whole of the current in the line CD, excepting that which flows through the motor armature A and field coils F_1, thus traverses the generator armature B and the generator field coils F_2. When the current in the circuit is small, the field magnets of the generator will be but feebly excited, and the armature B will generate no appreciable E.M.F.; in these circumstances there will be no appreciable E.M.F. generated; but since there will also be no appreciable drop in the circuit, the boosting action is not required. But when there is a considerable current in the circuit, and consequently a large drop occurs in the mains, the field magnets of the generator will become strongly excited, and the armature B will generate an appreciable E.M.F. Thus in passing through the generator, a rise of potential occurs which compensates for the drop between the central supply station and the point in question. In this case, the volts are raised at the expense of the current which is consumed by the motor A.

Problem.—At a point in a two-wire system at which the drop amounts to 10 volts, it is required to boost up the voltage to its original value of 100 volts. If the current in the circuit is equal to 200 ampères, what current will the motor require, the efficiency of the motor-generator being 90 per cent.?

Let the current required by the motor be equal to C ampères. Then the watts supplied to the motor will be equal to 90 C, since there will be a pressure of 90 volts across its terminals.

The E.M.F. of the generator must be equal to 10 volts, in

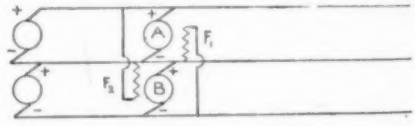

Fig. 3.

order to compensate for the given drop; then the energy developed by the generator will be equal.

Current traversing generator × E.M.F. of generator
= 200 × 10 = 2,000 watts.

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Since this is equal to 90 per cent. of the watts consumed by the motor, we have

$$2{,}000 = 0{\cdot}9 \times 90\,C = 81\,C.$$

$$\therefore C = \frac{2{,}000}{81} = 24{\cdot}7 \text{ ampères.}$$

Fig. 3 represents diagrammatically a boosting arrangement for a three-wire system. Two exactly similar armatures are keyed on to a common shaft, the armature A being connected between the upper and middle mains, while the armature B is connected between the middle and lower mains. The field coils F_1 of machine A are connected between the middle and lower mains, while F_2, the field coils of machine B, are connected between the upper and middle mains. When the two circuits are equally loaded, both of the field magnet systems will be equally excited, and the machines will have equal P.D.'s across their armatures. Thus both machines will act as motors, each requiring power sufficient for running light. In this case neither circuit is affected, except by the small increase of current necessary for the motor.

Now let us suppose that the upper circuit is overloaded in comparison with the lower circuit. Then the P.D. between the upper and middle mains will be diminished, and this will decrease the excitation of the field coils F_2. This will cause the armature B to rotate more quickly, since the smaller the field in the air gap, the greater is the speed of a motor for a given P.D. between its brushes. The armature A, being keyed to the same shaft as B, will thus be driven at an enhanced speed, and the E.M.F. generated will be greater than that between the upper and middle mains. Thus A will act as a generator, supplying current to the upper (overloaded) circuit; while B will act as a motor, taking current from the lower (underloaded) circuit.

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BY FRANK CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mechanics, Geometry, etc., Morley College, London; Author of "Elementary Practical Physics," "Practical Mathematics," etc.

FLUIDS.—The definitions relating to solids and fluids should be carefully made out from any text-book on the subject. It is unnecessary to attempt to give such at any length in these notes. The following short notes may be useful.

A *solid* may be defined as a portion of matter having a definite *size* and *shape*, and which offers resistance to any change of size or shape.

A *liquid* is a body having *size but not shape*, or, in other words, it merely takes the shape of the containing vessel.

A *gas* has neither *size nor shape*. The two latter are usually included in the term "*fluids*."

A fluid offers no resistance to change of shape. In the case of liquids, although the shape assumed will be that of the containing vessel, the volume, except under great pressures, cannot be sensibly altered. Thus with water the fractional change of volume due to a change of pressure of one atmosphere (14·7 lbs.) is about $\frac{1}{20000}$; hence liquids are said to be *incompressible*.

The pressure of a liquid may be due to its weight, and is therefore directly proportional to its height, or "*head*," above some given level. The upper surface of the liquid is called the *free surface*.

Gases are elastic and compressible, entirely filling any closed vessel in which they are placed; hence gases have no *free surface*. It should be noted that the behaviour of a liquid in contact with a surface is as if it were composed of very hard and minute spheres. The pressure exerted is at every point perpendicular to the surface. The *pressure or thrust* of a liquid is defined to be the *intensity of the pressure per unit area*.

The pressure at a point is a term used to denote the actual pressure on a small area enclosing the point.

Whole Pressure.—If $\bar{z}$ is the depth of the centre of area of a plane below the free surface of the liquid, and if A denotes the area and w the weight of unit volume of the liquid, then the whole pressure is given by $w\mathrm{A}\bar{z}$.

The proof may be readily obtained as follows:—Let a_1 denote a small element of surface at a depth z_1 from the surface. The pressure on such an element is the weight of a prism of liquid, area of base a_1, height z_1; hence the volume of the prism is a_1z_1, and its weight wa_1z_1.

In a similar manner, if $a_2, a_3 \ldots$ denote other elements at distances $z_2, z_3 \ldots$, then the weights, and therefore the pressures, are wa_2z_2, $wa_3z_3 \ldots$

Hence the whole pressure on the area is given by

$$w(a_1z_1 + a_2z_2 + a_3z_3 + \ldots),$$

if $\bar{z}$ be the distance of centre of area, or centre of gravity.

$$\bar{z} = \frac{a_1z_1 + a_2z_2 + a_3z_3 + \ldots}{a_1 + a_2 + a_3 + \ldots},$$

or, using the usual symbol Σ to denote the sum,

$$\bar{z} = \frac{\Sigma(az)}{\Sigma(a)} = \frac{\Sigma(az)}{\mathrm{A}}.$$

$$\therefore \bar{z}\mathrm{A} = \Sigma(az).$$

Hence total pressure $= w\mathrm{A}\bar{z}$. . . . . (1)

This may be expressed in words as follows:—The whole pressure on a given surface is the sum of the pressures on each element of area, and is equal to the area of the surface, multiplied by the pressure at its centre of gravity, or is the product of the area, the depth of the centre of gravity, and the weight of unit volume of liquid.

Obviously the area and the depth must be expressed in the same units (inches, feet, or centimetres). w will then denote the weight of a cubic inch, a cubic foot, or one gram respectively.

If the pressure of the air is *not* to be neglected, then (1) becomes

$$p = w\mathrm{A}\bar{z} + p_0, \quad . . . . . (2)$$

where p_0 denotes the atmospheric pressure; or $\bar{z}$ may be taken to be the depth of the "effective surface"—that is, a surface at a height h above the surface of the liquid, where h denotes the height of the barometer made of that liquid.

From Eq. (2) it follows that the intensity of pressure is the same at all points on a horizontal plane.

Thus the pressure at any two points is given by $wh + p_0$ and $wh_1 + p_0$, and $h = h_1$.

In addition to the preceding, the following are of frequent occurrence, and should be clearly made out.

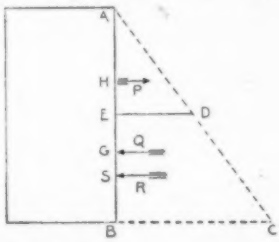
Resultant Pressure.—The simplest case is that of a plane surface. The pressures on the elements of the surface will form a system of like parallel forces. The resultant of such a system is a force equal to their sum. The whole pressure is equal to, and coincides with, the resultant pressure.

Centre of Pressure.—The centre of pressure is the centre of the parallel forces referred to, or is that point in the area at which the resultant pressure may be assumed to act—in other words, the centre of pressure of a plane area is the point at which the thrust of the liquid may be supposed to act as a single concentrated force. In simple cases, such as a vertical rectangle, the centre of pressure is readily obtained; in others it presents some difficulty, and the integral calculus may be required.

Ex. 1. (*a*) A rectangle is immersed in water, with its plane vertical and its upper edge in the surface of the water. Find the position of the centre of pressure.

(*b*) If a line is drawn across the rectangle, bisecting the two vertical sides, find the centre of pressure of the lower of the two parts. (1897.)

(*a*) Let AB denote the rectangle. The pressure against AB is zero at the free surface, increases with the depth, and becomes



a maximum at the lowest point, B. If the line BC to any convenient scale denotes the pressure at B, then, joining C to A, the pressure at any point along AB can be obtained by drawing at the point a line parallel to BC. The centre of area of a triangle ABC is in a line parallel to BC and passing through G, where $\mathrm{BG} = \frac{1}{3}\mathrm{BA}$. It follows therefore that, if a cylindrical barrel be full of fluid, the staves may be kept in place by a single hoop placed at a distance of $\frac{2}{3}$ the depth of the barrel.

(*b*) To find the centre of pressure of the lower part, we may consider two unlike parallel forces—one acting at H, where $\mathrm{EH} = \frac{1}{3}\mathrm{EA}$, and the other the resultant pressure of the whole rectangle acting at G.

Let P denote the force at H, and Q the force at G. Then from (1) we obtain—

$$\mathrm{P} = \frac{bl}{2} \times \frac{l}{4} = \frac{bl^2}{8}, \quad . . . . . (i)$$

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$$\text{and } Q = bl \times \frac{l}{2} = \frac{bl^2}{2}. \quad \ldots\ldots\ldots \quad \text{(ii)}$$

The resultant $R = Q - P = \frac{bl^2}{2} - \frac{bl^2}{8} = \frac{3}{8}bl^2$.

Let x denote the distance of R from G. Then, as $HG = \frac{l}{3}$, by taking moments about G, we obtain—

$$P \times \frac{l}{3} = R \times x.$$

$$\therefore \frac{bl^2}{8} \times \frac{l}{3} = \frac{3}{8}bl^2 \times x.$$

$$\therefore x = \tfrac{1}{9}l.$$

Hence the distance of S from A is

$$\tfrac{3}{9}l + \frac{l}{9} = \tfrac{4}{9}l.$$

Ex. 2. A rectangular plate, 8 inches long and 4 inches wide, is immersed in water, with its shorter edge horizontal and at a depth of 12 inches below the surface. The plate is inclined at an angle of 45° to the horizon. Find the whole pressure on it.

The depth of the centre of gravity of the plate is $12 + 4 \cos 45° = 12 + \frac{4}{\sqrt{2}} = 12 + 2\sqrt{2}$ inches.

Area of plate, $\frac{4 \times 8}{144}$ square feet.

$$\therefore \text{whole pressure} = \frac{(12 + 2\sqrt{2})}{12} \times \frac{32}{144} \times w.$$

If w, the weight of a cubic foot of water, be taken to be 62·5 lbs., then we obtain—

$$\text{whole pressure} = \frac{(12 + 2\sqrt{2})}{12} \times \frac{32}{144} \times 62{\cdot}5 \text{ lbs.} = \underline{17{\cdot}17 \text{ lbs.}}$$

Ex. 3. A hollow cone filled with water is held with its vertex downwards and axis vertical. The length of the axis is 12 feet, and radius of base 5 feet. Find the whole pressure on its surface. (1894.)

Let r denote the radius of the base, and h the length of the axis.

$\therefore$ Length of a slant side $= \sqrt{r^2 + h^2}$.

Area of curved surface $= \pi r \sqrt{r^2 + h^2}$.

The surface of the cone may be assumed to be divided into small elementary triangles, and since the centre of gravity of each triangle is at a depth $\frac{1}{3}h$ below the surface of the fluid, it follows that $\frac{1}{3}h$ is the depth of the centre of gravity of the surface. Hence $\bar{z} = \frac{h}{3}$.

$$\therefore \text{total pressure} = w\pi hr\sqrt{r^2 + h^2} \div 3. \quad \ldots\ldots\ldots \quad \text{(i)}$$

Substituting the values $r = 5$, $h = 12$, $w = 62{\cdot}5$ lbs. in (i),

$\therefore$ total pressure $= \underline{51070 \text{ lbs.}}$

The elementary methods referred to can only be used in simple cases, and although various geometrical artifices may be used with advantage in a few special examples, it is much better to use general formulæ.

It may be advisable to first obtain the general formulæ, and afterwards show their application to a few numerical examples.

Total Pressure.—It is convenient to take two axes of reference—one axis, oy, in the surface of the liquid; and the other, ox, at right angles to it.

Let A be a given plane area, x and y the co-ordinates of an element of area δa, and let ϕ denote the inclination of the area to the vertical.

The whole pressure on an element of area is

$$\delta ax \cos \phi w, \quad \ldots\ldots\ldots \quad (1)$$

and the total pressure $= w\Sigma\delta ax \cos \phi$.

From (1) the moments about the two axes will be $\delta ax \cos \phi wx$ and $\delta ax \cos \phi wy$. As the moment of the resultant about a given axis is equal to the sum of the moments of all the elementary forces about the same axis, we obtain

$$\left.\begin{aligned} R\bar{x} &= w \cos \phi \Sigma \delta a x^2 \\ \text{and } R\bar{y} &= w \cos \phi \Sigma \delta a x y \end{aligned}\right\}, \quad \ldots\ldots \quad (2)$$

where $\bar{x}$ and $\bar{y}$ denote the co-ordinates of the centre of pressure.

By definition, $\Sigma\delta ax^2$ is the moment of inertia of the area about the axis of Y, denoting this by I. Then, from Eq. (2),

$$R\bar{x} = w \cos \phi I,$$

if $\bar{x}$ denote the co-ordinate of the centre of area.

Total pressure $= w\Sigma\delta ax \cos \phi = wA\bar{x} \cos \phi$.

But we have already found that in the case of a plane area the total and resultant pressures are the same.

$$\therefore \bar{x} = \frac{wI \cos \phi}{wA^x \cos \phi} = \frac{I}{A^x}, \quad \ldots\ldots \quad (3)$$

$$\bar{\bar{y}} = \frac{\Sigma\delta axy}{A\bar{x}}. \quad \ldots\ldots\ldots \quad (4)$$

The position of the centre of pressure may be found from (3) and (4).

In many cases one line passing through the centre of pressure is known, and it is therefore only necessary to find the numerical value of the other. It will be noticed that as (3) and (4) do not contain the angle ϕ, the position of the centre of pressure is independent of the inclination of the plane.

Eq. (3) is of the utmost importance. It may be applied to the simplest cases; it may also be used to obtain an expression for the distance between the centre of pressure and the centre of gravity.

Thus, if I_0 denotes the moment of inertia of a plane area about a line passing through its centre of area, then I about any line parallel to the former and at a distance $\bar{x}$ from it is given by $I = I_0 + A\bar{x}^2$. Also, if k denotes the radius of gyration, then $I = Ak^2$. Substituting,

$$\bar{\bar{x}} = \frac{Ak^2 + A\bar{x}^2}{A\bar{x}} = \frac{k^2}{\bar{x}} + \bar{x}. \quad \ldots\ldots \quad (5)$$

From (5) it follows that the centre of pressure is always below the centre of gravity. When $\bar{x}$ is large compared with k^2, the value of $\frac{k^2}{\bar{x}}$ is very small, and may be neglected, and the centre of pressure may be taken to coincide with the centre of gravity. When the area is horizontal, $\bar{\bar{x}}$ is obviously equal to $\bar{x}$.

Ex. 4. Find where the centre of pressure of a rectangle would be if its plane were vertical, and its upper edge (which is horizontal) below the surface of the water, at a distance equal to the height of the rectangle.

The position may be found as in Ex. 1, or by Eq. (3). Let b and d be the two sides of the rectangle, the side b being horizontal.

$$I_0 = \tfrac{1}{12}bd^3, \text{ distance between axes } \tfrac{3}{2}d.$$

$$\therefore I = \tfrac{1}{12}bd^3 + bd \times \left(\frac{3d}{2}\right)^2 = \tfrac{7}{3}bd^3.$$

$$\therefore \bar{\bar{x}} = \frac{\tfrac{7}{3}bd^3}{bd \times \tfrac{3}{2}d} = \tfrac{1}{9}^4 d.$$

Ex. 5. Find the centre of pressure of a plane circular area just immersed in water, with its plane vertical. (1885.)

$$\text{Here } I_0 = \frac{\pi}{64}d^4.$$

$$\therefore I = \frac{\pi}{64}d^4 + \frac{\pi}{4}d^2\left(\frac{d}{2}\right)^2 = \tfrac{5}{6}^5\pi d^4.$$

$$\bar{\bar{x}} = \frac{\tfrac{5}{6}^5\pi d^4}{\frac{\pi}{4}d^2 \times \frac{d}{2}} = \tfrac{5}{8}d.$$

Ex. 6. Define the "centre of pressure" of a plane area immersed in a liquid.

Suppose that a horizontal plane is drawn through the highest point of the immersed plane area, part of the pressure of the liquid on the area will be due to the liquid above the horizontal plane. Find that part of the pressure, and show that it will act through the centre of gravity of the area.

Hence show that the centre of pressure will always be below the centre of gravity, but will be nearer to it in proportion as the depth of the above-mentioned horizontal plane is increased. (1901.)

Ex. 7. State the position of the centre of pressure of a vertical rectangle with one side in the surface of the fluid.

If the height of the rectangle be 1 foot, find the position of the centre of pressure, taking into account the atmospheric pressure of 14·7 lbs. per square inch. (1899.)

Ex. 8. Investigate the resultant pressure of a liquid on an immersed closed surface.

A solid hemisphere is just immersed, with its base horizontal and downwards. Show that the whole pressure on the surface is three times the resultant pressure of the liquid on it. (1900.)

Ex. 9. Find the centre of pressure of any parallelogram one of whose sides is coincident with the surface of the fluid. Prove that if a cylindrical barrel be full of fluid, the staves may be kept in their places by a single hoop properly placed. (1902.)

Ex. 10. Find the resultant thrust in a given direction on a given surface immersed in a fluid.

A cone full of water is held with a slant side horizontal. Compare the thrust on its base with the weight of the fluid, 2α being the vertical angle of the cone. (1901.)

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F. W. T., Balance-Wheel.—A watch has a non-compensated brass balance-wheel and a steel balance-spring. How many seconds will it lose per day for 1° C. rise of temperature if the coefficient of linear expansion of brass is 18×10^{-6}, and Young's modulus for steel at $t°$ C. is $2 \times 10^{12}\left(1 - \frac{2t}{10^4}\right)$?

(B.Sc., London, Experimental Physics, Oct. 1902.)

The time of vibration T (in seconds) of a balance-wheel, controlled by a spiral hairspring, is given by

$$T = 2\pi\sqrt{\frac{Il}{Y}},$$

where I is the moment of inertia of the wheel about the axis of rotation, l is the length of the spring, and Y is Young's modulus of the substance of which the spring is composed. For a proof of this formula, see Routh, *Rigid Dynamics*, chap. iii.

Let M = mass of balance-wheel, while k = its radius of gyration. Then $I = Mk^2$. If the mass of the spokes of the wheel is small, so that we may consider the whole mass to be concentrated at the rim of the wheel, k will be equal to the radius of the rim of the wheel. In any case

$$T = \frac{2\pi k\sqrt{Ml}}{\sqrt{Y}}.$$

A rise of temperature will affect each of the three quantities k, l, and Y which determine the time of oscillation. The wheel will expand, thus increasing k; the length l of the spring will increase; and, in addition, the modulus of the spring will be diminished. We may, however, neglect the effect of the increased length of the spring, since the coefficient of linear expansion of steel is very small. Then, if a is the coefficient of linear expansion of the brass wheel, a rise of 1° C. will change k into $k(1 + a)$. If y is the temperature coefficient of Young's modulus of the spring, a rise of 1° C. will change Y into $Y(1 + y)$. Thus, if T_1 is the time of oscillation when the temperature has increased by 1° C., we shall have

$$T_1 = \frac{2\pi k(1+a)\sqrt{Ml}}{\sqrt{Y(1+y)}} = \frac{T(1+a)}{\sqrt{1+y}}.$$

Then rearranging the terms, expanding by the binomial theorem, and neglecting the squares and higher powers of the small quantities a and y, we obtain

$$\frac{1}{T_1} = \frac{1}{T}\frac{\sqrt{1+y}}{1+a} = \frac{1}{T}\left(1 + \tfrac{1}{2}y + \ldots\right)(1 - a + \ldots)$$

$$= \frac{1}{T}\{1 - (a - \tfrac{1}{2}y)\}.$$

$$\therefore \frac{1}{T} - \frac{1}{T_1} = \frac{1}{T}(a - \tfrac{1}{2}y).$$

There are 86,400 seconds in 24 hours, and therefore $86,400/T$ gives the number of oscillations of the balance-wheel in 24 hours, when the temperature is normal; the number of oscillations in 24 hours when the temperature has risen by 1° will similarly be equal to $86,400/T_1$. Therefore the decrease in the number of oscillations in 24 hours, due to a rise of 1° C., is equal to

$$86,400\left(\frac{1}{T} - \frac{1}{T_1}\right) = \frac{86,400}{T}(a - \tfrac{1}{2}y).$$

Since the watch, at the higher temperature, loses T seconds for every oscillation by which it falls behind the watch at the lower temperature, the number of seconds lost in 24 hours, due to a rise of 1° C., is found by multiplying the left-hand side of the last equation by T. Thus

$$86,400T\left(\frac{1}{T} - \frac{1}{T_1}\right) = 86,400(a - \tfrac{1}{2}y),$$

which gives the number of seconds lost per day per degree rise of temperature. From the data given

$$a = 18 \times 10^{-6}$$
$$y = -2 \times 10^{-4}.$$
$$\therefore a - \tfrac{1}{2}y = (18 + 100)10^{-6} = 1{\cdot}18 \times 10^{-4}.$$

$\therefore$ number of seconds lost per day per degree rise of temperature $= (8{\cdot}64 \times 10^4) \times (1{\cdot}18 \times 10^{-4}) = 10{\cdot}2$ seconds (nearly).

Electron.—A glass globe contains unsaturated moist air, and the pressure is so adjusted that, on opening a stop-cock communicating with the external air, a very slight cloudiness is produced. Show that if the initial and final pressures of the air and its hygrometric state and temperature are known, we can calculate the ratio of the specific heats of the moist air.

(Board of Education, Heat, Honours (I.), 1902.)

Let p_1, v_1, and T_1 be the pressure, volume, and absolute temperature of the moist air after it has been compressed and allowed to attain the temperature of the surrounding atmosphere. On opening the stop-cock the pressure falls to p_2, which is equal to the atmospheric pressure; while, since a slight cloudiness is produced, the temperature falls to the dew-point of the air. Since the hygrometric state of the air is known, its dew-point is known, and the corresponding absolute temperature T_2 can be found. Let v_2 be the (unknown) volume which the air attains in expanding. Then, assuming the expansion to have occurred adiabatically, we have—

$$p_1 v_1^{\gamma} = p_2 v_2^{\gamma}, \quad \ldots\ldots\ldots \quad (1)$$

where γ is the ratio of the specific heats of the air. Also, since the air at pressure p_1 and volume v_1 is on the T_1 isothermal, while at pressure p_2 and volume v_2 it is on the T_2 isothermal, we have—

$$\left.\begin{aligned} p_1 v_1 &= RT_1 \\ p_2 v_2 &= RT_2 \end{aligned}\right\} \therefore \frac{v_1}{v_2} = \frac{p_2 T_1}{p_1 T_2}. \quad \ldots\ldots \quad (2)$$

$$\text{From (1)} \left(\frac{v_1}{v_2}\right)^{\gamma} = \frac{p_2}{p_1}.$$

Substituting the value of v_1/v_2 from (2), we obtain—

$$\left(\frac{p_2 T_1}{p_1 T_2}\right)^{\gamma} = \frac{p_2}{p_1}.$$

$$\therefore \gamma\{\log(p_2 T_1) - \log(p_1 T_2)\} = \log p_2 - \log p_1.$$

$$\therefore \gamma = \frac{\log p_2 - \log p_1}{\log(p_2 T_1) - \log(p_1 T_2)}.$$

Thus γ becomes known in terms of p_1 (the initial pressure), p_2 (the final pressure), T_1 (the initial absolute temperature), and T_2 (the final absolute temperature) of the air.

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A. D. Lampitt.—Solve the equation

$$\left.\begin{aligned}\frac{(ac+1)(x^2+1)}{x+1} &= \frac{(a^2+1)(xy+1)}{y+1}\\ \frac{(ac+1)(y^2+1)}{y+1} &= \frac{(c^2+1)(xy+1)}{x+1}\end{aligned}\right\}.$$

(Briggs and Bryan's *Advanced Tutorial Algebra.*)

Multiplying the given equations together, we obtain

$$(ac+1)^2(x^2+1)(y^2+1) = (xy+1)^2(a^2+1)(c^2+1).$$

Expanding and collecting terms, we obtain

$$a^2c^2(x^2-2xy+y^2)+2ac(x^2-2xy+y^2)+x^2-2xy+y^2 = x^2y^2(a^2-2ac+c^2)+2xy(a^2-2ac+c^2)+a^2-2ac+c^2.$$

$$\therefore (ac+1)^2(x-y)^2 = (xy+1)^2(a-c)^2.$$

$$\therefore (ac+1)(x-y) = \pm(xy+1)(a-c). \quad . \quad . \quad . \quad . \quad \text{(i)}$$

Taking the upper sign in (i), we have

$$acx - acy + x - y = axy - cxy + a - c.$$

$$\therefore x = \frac{a-c+acy+y}{ac+cy-ay+1}. \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(ii)}$$

Substituting in the second of the given equations, we have

$$\frac{(ac+1)(y^2+1)}{y+1} = (c^2+1)\frac{ay-cy+acy^2+y^2+ac+cy-ay+1}{a-c+acy+y+ac+cy-ay+1}$$

$$= (c^2+1)\frac{(ac+1)(y^2+1)}{(ac+c-a+1)y+ac-c+a+1}.$$

$$\therefore \frac{1}{y+1} = \frac{c^2+1}{(ac+c-a+1)y+ac-c+a+1}.$$

$$\therefore (ac+c-a+1)y+ac-c+a+1 = (c^2+1)y+c^2+1.$$

$$\therefore (c^2-ac-c+a)y = ac-c+a-c^2.$$

$$\therefore (c-1)(c-a)y = (c+1)(a-c).$$

$$\therefore y = \frac{1+c}{1-c}.$$

Substituting in (ii), we have

$$x = \frac{a-c+ac\dfrac{1+c}{1-c}+\dfrac{1+c}{1-c}}{ac+c\dfrac{1+c}{1-c}-a\dfrac{1+c}{1-c}+1}.$$

$$\therefore x = \frac{(a-c)(1-c)+(1+c)(ac+1)}{(ac+1)(1-c)+(1+c)(c-a)}$$

$$= \frac{a-ac-c+c^2+ac+ac^2+c+1}{ac-ac^2-c+1+c-a^2+c^2-ac}$$

$$= \frac{(c^2+1)(a+1)}{(c^2+1)(1-a)} = \frac{1+a}{1-a}.$$

Similarly, by taking the lower sign in (i), we obtain

$$x = \frac{1-a}{1+a},\quad y = \frac{1-c}{1+c}.$$

J. B. Holmyard.—Prove that

$$\frac{\cos^2\theta}{\sin(\theta-\alpha)\sin(\theta-\beta)\sin(\theta-\gamma)} = \frac{\cos^2\alpha}{\sin(\theta-\alpha)\sin(\alpha-\beta)\sin(\alpha-\gamma)} + \frac{\cos^2\beta}{\sin(\theta-\beta)\sin(\beta-\alpha)\sin(\beta-\gamma)} + \frac{\cos^2\gamma}{\sin(\theta-\gamma)\sin(\gamma-\alpha)\sin(\gamma-\beta)}.$$

(College of Preceptors, Licentiateship, 1901.)

Let $$\frac{\cos^2\theta}{\sin(\theta-\alpha)\sin(\theta-\beta)\sin(\theta-\gamma)} \equiv \frac{A}{\sin(\theta-\alpha)} + \frac{B}{\sin(\theta-\beta)} + \frac{C}{\sin(\theta-\gamma)},$$

where A, B, and C have to be determined. Then

$$\cos^2\theta \equiv A\sin(\theta-\beta)\sin(\theta-\gamma) + B\sin(\theta-\gamma)\sin(\theta-\alpha) + C\sin(\theta-\alpha)\sin(\theta-\beta).$$

Since this is an identity, it is true for all values of θ.

Let $\theta = \alpha$. Then we have

$$\cos^2\alpha = A\sin(\alpha-\beta)\sin(\alpha-\gamma),$$

the remaining terms of the right-hand side disappearing, since each of them contains the factor $\sin(\alpha-\alpha)$.

$$\therefore A = \frac{\cos^2\alpha}{\sin(\alpha-\beta)\sin(\alpha-\gamma)}.$$

Similarly, by making $\theta = \beta$ in the identity, we have

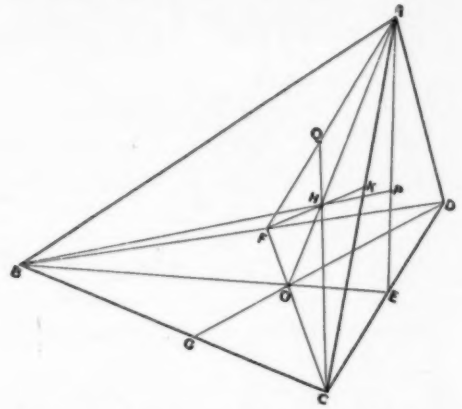
$$B = \frac{\cos^2\beta}{\sin(\beta-\alpha)\sin(\beta-\gamma)}.$$

Also, by making $\theta = \gamma$ in the identity, we have

$$C = \frac{\cos^2\gamma}{\sin(\gamma-\alpha)\sin(\gamma-\beta)}.$$

$$\therefore \frac{\cos^2\theta}{\sin(\theta-\alpha)\sin(\theta-\beta)\sin(\theta-\gamma)} = \frac{\cos^2\alpha}{\sin(\theta-\alpha)\sin(\alpha-\beta)\sin(\alpha-\gamma)} + \frac{\cos^2\beta}{\sin(\theta-\beta)\sin(\beta-\alpha)\sin(\beta-\gamma)} + \frac{\cos^2\gamma}{\sin(\theta-\gamma)\sin(\gamma-\alpha)\sin(\gamma-\beta)}.$$

Carrett.—In a tetrahedron, whose opposite edges are at right angles in pairs, the four perpendiculars drawn from the vertices to the opposite faces, and the three shortest distances between opposite edges, are concurrent. (Hall and Stevens' *Euclid.*)



Let ABCD be the given tetrahedron, having the opposite edges at right angles in pairs—namely, AB at right angles to CD, AC at right angles to BD, and, therefore, AD at right angles to BC. From B, C, D, the vertices of the triangular face BCD, draw the perpendiculars BE, CF, DG to the opposite sides of the triangle BCD. Then, by a well-known deduction, these perpendiculars intersect in the same point O, which is known as the orthocentre of the triangle. Join AO. Then, because CD is perpendicular to AB (hypothesis) and also to BE (construction), therefore CD is perpendicular to the plane ABE. Hence CD is perpendicular to AO, which lies in the plane ABE. Similarly, CB is perpendicular to AO. Hence AO is perpendicular to both BC and CD. Therefore AO is perpendicular to the face BCD. It follows, therefore, that the perpendicular drawn from any vertex of the tetrahedron to the opposite face, cuts that face at its orthocentre.

Hence, if from C, CQ is drawn perpendicular to the face ABD and meeting it in Q, then Q is the orthocentre of the triangle ABD. Hence perpendiculars drawn from A and C upon BD meet at F.

Let AO, CQ intersect at H. Then, since H is the intersection of perpendiculars from the vertices of the triangle AFC upon the opposite sides of that triangle, therefore H is the orthocentre of the triangle ACF. Hence if FH be joined and produced to meet AC in K, therefore FK is perpendicular to AC. But BD is perpendicular to the plane AFC, therefore FK is also perpendicular to BD.

Hence FK is perpendicular to both of the opposite edges BD, AC, and is therefore the shortest distance between them. Similarly, we may show that the shortest distance between BC and AD, and the shortest distance between CD and AB both pass through the point H.

Join BH, and produce it to meet the face ACD in P. Then, because CD is perpendicular to AB (hypothesis), and also to BE (construction), CD is perpendicular to the plane ABE—that is, perpendicular to the plane AOP. Hence the plane ACD is perpendicular to the plane APO. Similarly, the plane ACD is perpendicular to the plane CPQ. Therefore ACD is perpendicular to BH, the common section (produced) of the planes APO and CPQ. Hence BH produced to meet the face ACD in P is perpendicular to ACD. Similarly, DH produced may be shown to be perpendicular to ABC. Hence all the perpendiculars drawn from the angular points of the given tetrahedron upon the opposite faces pass through the same point H; and we have shown that each of the shortest distances between opposite edges passes through the same point.

Puzzled.— If $\frac{a}{b} = \frac{c}{d}$, show that

$$\frac{a+b}{a-b} = \frac{c+d}{c-d},$$

and that "$\frac{a}{c} = \frac{ma-nc}{ma+nd}$".

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Arum.—Show that the two parabolas $x^2 + 4a(y - 2b - a) = 0$, and $y^2 = 4b(x - 2a + b)$, intersect at right angles at the common end of the latus rectum of each.

(Loney's *Co-ordinate Geometry.*)

The given equations may be written—

$$y^2 = 4b\{x - (2a - b)\}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (i)$$

$$x^2 = -4a\{y - (2b + a)\}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (ii)$$

It is obvious that the vertex of (i) is at the point $(2a - b), 0$; and therefore the focus is at the point $(2a - b + b), 0$—that is, at $2a, 0$. Hence the ends of the latus rectum of (i) are at $2a, \pm 2b$. (See Loney's *Co-ordinate Geometry*, worked examples, page 178.)

Again, it is obvious that (ii) is a parabola with its axis parallel to the axis of y, and having its vertex upwards; also that its latus rectum has its ends at the points $\pm 2a, 2b$.

Hence the two parabolas have a common end of their latera recta at the point $(2a, 2b)$.

Now the tangent to (i) at the point $(2a, 2b)$ is

$$2by = 2b(x + 2a) - 4b(2a - b),$$

$$\text{or, } y = x - 2(a - b). \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (iii)$$

Again, the tangent to (ii) at the point $(2a, 2b)$ is

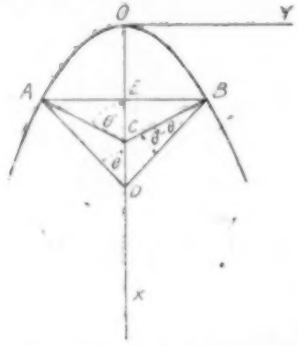
$$2ax = -2a(y + 2b) + 4a(2b + a),$$

$$\text{or, } x = -y + 2(a + b). \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (iv)$$

But the lines (iii) and (iv) are at right angles, therefore the tangents to the parabolas at the common end of the latus rectum of each are at right angles.

Hence the given parabolas intersect at right angles at the common end of the latus rectum of each. *Q.E.D.*

Fiddler.—AC, BC are two equal uniform rods which are jointed at C, and have rings at the ends A and B which slide on a smooth parabolic wire, whose axis is vertical and vertex upwards. Prove that in the position of equilibrium the distance of C from AB is $\frac{1}{4}$ latus rectum.



As far as the statement of the problem is concerned, it would be legitimate to simply quote the well-known proposition: In a parabola the subnormal is equal to the semi-latus rectum. Or the proposition may be proved as follows:—

Let the equation to the parabola be denoted by $y^2 = 4ax$.

Let the co-ordinates of point B be $x'y'$.

Then BD, the normal at B, is

$$y - y' = -\frac{y'}{2a}(x - x'). \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The point where the line given by (1) cuts the axis of X is obtained by putting $y = 0$.

$\therefore$ from (1), $x = 2a + x'$.

But $OE = x'$. $\therefore$ $ED = 2a$.

Let reaction along DB be R, and let W denote the weight of each rod.

Then $R \cos\theta = W$. . . . . (2)

Taking moments about C for equilibrium of rod CB, we obtain

$$W l \sin\theta' = R \times 2l \sin(\theta' - \theta),$$

where $2l$ denotes the length of the rod.

From (2), $R \cos\theta \times l \sin\theta' = 2Rl \sin(\theta' - \theta)$.

$$\therefore \sin\theta' \cos\theta = 2\sin(\theta' - \theta)$$

$$= 2(\sin\theta' \cos\theta - \cos\theta' \sin\theta),$$

$$\text{or, } 2\sin\theta \cos\theta' = \sin\theta' \cos\theta.$$

$$\therefore 2\tan\theta = \tan\theta'.$$

Hence $ED = 2EC$.

But $ED = 2a$.

$\therefore$ $EC = a$.

Bike.—Prove that a circle can be drawn through the foci of a hyperbola and the points in which any tangent meets the tangents at the vertices.

(Loney's *Co-ordinate Geometry.*)

Let $b^2x^2 - a^2y^2 = a^2b^2$ be the equation of the hyperbola. Then if x', y' be any point on the curve, the tangent at that point is given by the equation—

$$b^2x'x - a^2y'y = a^2b^2. \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The co-ordinates of the vertices are (a, o), $(-a, o)$; and the tangents at these points are—

$$x = a. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$x = -a. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

(1) and (2) intersect in the point $a, \frac{b^2(x' - a)}{ay'}$; (1) and (3) in the point $-a, -\frac{b^2(x' + a)}{ay'}$. Further, the co-ordinates of the foci are $\pm\sqrt{a^2 + b^2}, 0$. Now, any circle passing through the foci will have its centre on the conjugate axis. Hence the equation of the circle may be written—

$$x^2 + y^2 + 2fy + c = 0. \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

But the condition that the foci $\pm\sqrt{a^2 + b^2}, 0$ are on the circle (4) is given by the equation—

$$a^2 + b^2 + c = 0;$$

hence (4) may be written—

$$x^2 + y^2 + 2fy - a^2 - b^2 = 0. \quad . \quad . \quad . \quad (5).$$

Again, the condition that the intersection of the tangents (1) and (2) $\left(\text{namely, the point } a, \frac{b^2(x' - a)}{ay'}\right)$ shall be on the circle (5) is given by the equation—

$$a^2 + \frac{b^4(x' - a)^2}{a^2y'^2} + 2f\frac{b^2(x' - a)}{ay'} - a^2 - b^2 = 0.$$

$$\therefore 2f = \frac{a^2y'^2 - b^2(x' - a)^2}{(x' - a)ay'}.$$

But x', y' is on the hyperbola, therefore—

$$a^2y'^2 = b^2(x'^2 - a^2).$$

$$\therefore 2f = \frac{b^2[(x'^2 - a^2) - (x' - a)^2]}{(x' - a)ay'} = \frac{2b^2}{y'}.$$

Hence (5) may be written—

$$x^2 + y^2 + \frac{2b^2}{y'}y - a^2 - b^2 = 0. \quad . \quad . \quad . \quad (6)$$

The condition that the point of intersection of the tangents (1) and (3) $\left(\text{namely, the point } -a, -\frac{b^2(x' + a)}{ay'}\right)$ shall be on the circle (6), is that the expression—

$$a^2 + \frac{b^4(x' + a)^2}{a^2y'^2} - \frac{2b^2}{y'}\cdot\frac{b^2(x' + a)}{ay'} - a^2 - b^2 \text{ shall vanish.}$$

This expression may be written—

$$\frac{b^4\{(x' + a)^2 - 2a(x' + a)\} - a^2b^2y'^2}{a^2y'^2};$$

$$\text{or } \frac{b^4\{(x' + a)^2 - 2a(x' + a) - (x'^2 - a^2)\}}{a^2y'^2},$$

for, since x', y' is on the hyperbola, $a^2y'^2 = b^2(x'^2 - a^2)$. But this expression vanishes, therefore the intersection of (1) and (3) lies on the circle (6) which passes through the foci and the intersection of (1) and (2).

Chars.—Prove that $\log_a r = \log_a b \cdot \log_b c \cdot \log_c d \ . \ . \ . \ \log_q r$.

(Lock's *Trigonometry for Beginners.*)

Let $\log_a b = y$,

$\log_b c = z$,

$\log_c d = u$,

. . . = . . .,

$\log_q r = v$,

Then, by definition, we have—

$a^y = b$ (i),

$b^z = c$ (ii),

$c^u = d$ (iii),

. . . = . . .,

$q^v = r$ (iv).

From (i) $b = a^y$. Substituting this value of b in (ii), we have $(a^y)^z = c$. Hence $a^{yz} = c$.

Similarly, we have $(a^{yz})^u = d$, therefore $a^{yzu} = d$.

Proceeding in this way, we may prove that $a^{yzu \ . \ . \ . \ v} = r$.

Hence, by definition, we have $\log_a r = yzu \ . \ . \ . \ v$.

$\therefore$ $\log_a r = \log_a b \cdot \log_b c \cdot \log_c d \ . \ . \ . \ \log_q r$.

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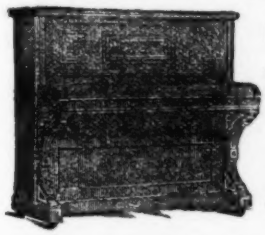

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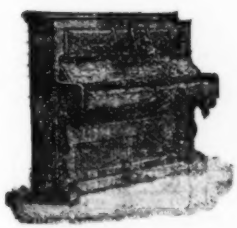

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Peto Lucem.—The vertex of a given angle $\tan^{-1}m$ moves along the axis of x, and one side always touches the parabola whose equation referred to rectangular axes is

$$(y + mx - c)^2 = 4mc(my - x).$$

Show that the other side passes through a fixed point.

(London B.Sc. Examination.)

The line $y + mx - c = 0$ is the axis of the parabola, and the line $my - x = 0$ is the tangent at the vertex. Changing the origin and axes so as to make the axis of the parabola the axis of x, and the tangent at the vertex the axis of y, the equation of the parabola becomes

$$y^2 = 4\frac{mc}{\sqrt{1+m^2}}x.$$

The co-ordinates of the old origin are $x = 0$, $y = -c\cos\theta$ where $\tan\theta = m$; the equation of the old axis of x is now

$$y + c\cos\theta = -x\tan\theta. \quad . \quad . \quad . \quad . \quad (1)$$

The equation of a tangent to the parabola is

$$y = nx + \frac{c\sin\theta}{n}. \quad . \quad . \quad . \quad . \quad . \quad (2)$$

The equation of a line through the intersection of (1) and (2) is

$$y + c\cos\theta + x\tan\theta = \lambda\left(y - nx - \frac{c\sin\theta}{n}\right). \quad . \quad (3)$$

that is,

$$y(\lambda - 1) = x(\tan\theta + \lambda n) + c\cos\theta + \frac{\lambda c}{n}\sin\theta. \quad . \quad (4)$$

Expressing that the angle between (4) and (2) is θ, or $\tan^{-1}m$, we have—

$$\frac{\tan\theta + \lambda n}{\lambda - 1} = \frac{n - \tan\theta}{1 + n\tan\theta}.$$

$$\text{Whence } \lambda = -\frac{n(1+\tan^2\theta)}{\tan\theta\,(1+n^2)}.$$

Thus (3) becomes

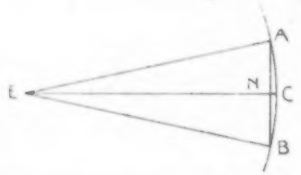
$$(y + c\cos\theta + x\tan\theta)\tan\theta\,(1+n^2) + (1+\tan\theta)(ny - n^2x - c\sin\theta) = 0.$$

Now this equation is satisfied, whatever the value of n, by $y = 0$, $x = c\sin\theta$.

Therefore when one side of the given angle touches the parabola, the other side passes through a fixed point $(0, c\sin\theta)$—namely, the intersection of the axis of the parabola with the original axis of y, which point in the case of the given equation is the focus of the parabola. Referred to the old origin and axes, this point is $(0, c)$.

Ralpho.—The moon's diameter subtends an angle of 30′ at the eye. How far away from the eye must a circular disc one foot in diameter be placed so as just to hide the moon? ($\pi = 3{\cdot}1416$.)

(University Preliminary, 1901.)



Let the disc ANB be so placed that the line joining the position (E) of the eye to the centre N of the disc is perpendicular to the plane of the disc, and bisects the given angle of 30′. From the centre E describe the circular arc ACB. Then the length of the arc ACB is equal to the product of EA and the radian measure of the angle AEB. Now the radian measure of the angle AEB is $\frac{30}{180\times 60}\pi = \frac{3{\cdot}1416}{360}$.

Hence the length of the arc ACB = EA $\times \frac{3{\cdot}1416}{360}$.

But AEB is a very small angle, therefore the chord AB is approximately equal to the arc ACB, and the perpendicular EN to the radius EA.

Therefore AB = EN $\times \frac{3{\cdot}1416}{360}$ (approximately).

$$\therefore \text{EN} = \frac{360}{3{\cdot}1416}\text{AB, where AB = 1 foot.}$$

$$\therefore \text{EN} = \frac{360}{3{\cdot}1416}\text{ feet} = \underline{114{\cdot}6\text{ feet (approximately).}}$$

C. Williams.—A balance has its arms unequal in length and in weight. A certain article appears to weigh Q_1 lbs. when placed in one scale-pan, and Q_2 lbs. when placed in the other. A certain other article appears to weigh R_1 lbs. R_2 lbs. respectively. Show that the weight of the article which appears to weigh the same in whichever scale it is put is

$$\frac{Q_1R_2 - Q_2R_1}{Q_1 - Q_2 - R_1 + R_2}\text{ lbs.}$$

Let the difference in weight be represented by a weight w in one scale-pan, and let k denote the ratio of the arms. Then, if Q and R be the true weights respectively, we have the relations—

$$\left.\begin{aligned} Q_1 &= Qk + wk \\ Q_2 &= \frac{Q}{k} - w \end{aligned}\right\}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and similarly,

$$\left.\begin{aligned} R_1 &= Rk + wk \\ R_2 &= \frac{R}{k} - w \end{aligned}\right\}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

We must eliminate Q and R from (1) and (2).

$\therefore$ from (1), $kQ = Q_1 - wk$.

$$\frac{Q}{k} = Q_2 + w.$$

That is, $Q = Q_1k^{-1} - w$

$$Q = Q_2k + wk$$

Subtracting, $Q_1k^{-1} - Q_2k = w(k+1)$. . . (3)

Similarly, we may obtain from (2)

$$R_1k^{-1} - R_2k = w(k+1). \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

$\therefore$ from (3) and (4) we obtain

$$k(R_2 - Q_2) = k^{-1}(R_1 - Q_1).$$

$$\therefore k^2 = \frac{R_1 - Q_1}{R_2 - Q_2}.$$

But from (1), $Q_1k^{-1} - Q_2k = w(k+1)$,

or, $Q_1 - Q_2k^2 = w(k^2 + k)$.

$$\therefore Q - Q_2\frac{R_1 - Q_1}{R_2 - Q_2} = w\frac{R_1 - Q_1}{R_2 - Q_2} + w\sqrt{\frac{R_1 - Q_1}{R_2 + Q_2}}.$$

Transposing,

$$w(R_1 - Q_1) + \sqrt{(R - Q_1)(R_2 - Q_2)} = Q_1R_2 - Q_1Q_2 - R_1Q_2 + Q_1Q_2.$$

$$\text{Hence } w = \frac{Q_1R_2 - R_1Q_2}{\sqrt{R_1 - Q_1}\{\sqrt{R_1 - Q_1} + \sqrt{R_2 - Q_2}\}}.$$

Now let W be the weight of an article weighing apparently the same in each pan. Then

$$W_1 = Wk + wk = W_2 = Wk^{-1} - w,$$

or, $Wk + wk = Wk^{-1} - w$.

$$W = w\frac{k+1}{k^{-1}+k} = w\frac{k^2+k}{1-k^2}.$$

Now, substituting for w, k^2, and k, we obtain

$$W = \frac{Q_1R_2 - R_1Q_2}{\sqrt{R_1 - Q_1}\{\sqrt{R_1 - Q_1} + \sqrt{R_2 - Q_2}\}} \cdot \frac{\left\{\frac{R_1 - Q_1}{R_2 - Q_2} + \sqrt{\frac{R_1 - Q_1}{R_2 - Q_2}}\right\}}{\left\{1 - \frac{R_1 - Q_1}{R_2 - Q_2}\right\}}$$

$$= \frac{(Q_1R_2 - R_1Q_2)\left\{\frac{R_1 - Q_1 + \sqrt{(R_1 - Q_1)(R_2 - Q_2)}}{R_2 - Q_2}\right\}}{\sqrt{R_1 - Q_1}\{\sqrt{R_1 - Q_1} + \sqrt{R_2 - Q_2}\}\left\{\frac{R_2 - Q_2 - R_1 + Q_1}{R_2 - Q_2}\right\}}$$

$$= \frac{(Q_1R_2 - R_1Q_2)\{\sqrt{R_1 - Q_1}\}\{\sqrt{R_1 - Q_1} + \sqrt{R_2 + Q_2}\}}{\sqrt{R_1 - Q_1}\{\sqrt{R_1 - Q_1} + \sqrt{R_2 + Q_2}\}\{R_2 - Q_2 - R_1 + Q_1\}}$$

$$= \frac{Q_1R_2 - R_1Q_2}{Q_1 - Q_2 - R_1 + R_2}.$$

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$$\cos A - \cos B - \sin(A - B)$$
$$= 2\sin\frac{B - A}{2}\left(\sin\frac{A}{2} + \cos\frac{A}{2}\right)\left(\sin\frac{B}{2} + \cos\frac{B}{2}\right).$$

(Tutorial *Trigonometry.*)

$$\cos A - \cos B - \sin(A - B)$$
$$= 2\sin\frac{B + A}{2}\sin\frac{B - A}{2} + 2\sin\frac{B - A}{2}\cos\frac{B - A}{2}$$
$$= 2\sin\frac{B - A}{2}\left\{\sin\frac{B + A}{2} + \cos\frac{B - A}{2}\right\}$$
$$= 2\sin\frac{B - A}{2}\left\{\sin\frac{B}{2}\cos\frac{A}{2} + \cos\frac{B}{2}\sin\frac{A}{2} + \cos\frac{B}{2}\cos\frac{A}{2} + \sin\frac{B}{2}\sin\frac{A}{2}\right\}$$
$$= 2\sin\frac{B - A}{2}\left\{\sin\frac{A}{2} + \cos\frac{A}{2}\right\}\left\{\sin\frac{B}{2} + \cos\frac{B}{2}\right\}.$$

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THE EDITOR'S TABLE

MR. YOXALL'S NEW NOVEL.*

THIS is undeniably a clever book, and reveals yet another facet of Mr. Yoxall's abounding versatility. From the Derbyshire moors and the Romany folk of his earlier work, Mr. Yoxall now flits to the boulevards and cafés of a provincial French town, and finds himself equally at home. Everywhere the book has the seal and impress of intimate knowledge; everywhere there are clever character drawing, clever descriptive writing, and a truly Gallic atmosphere.

The story, *in petto*, is that of a young, well-educated, somewhat dilettante tourist cicerone, who is an unwitting Count de Thanneguy, and therefore a personage of potential influence in the circles of Legitimist intrigue. The heroine has transatlantic blood in her veins. She is an enthusiastic Royalist, and she offers marriage to Tanger, in order that the ancient glories of the house with which she too is connected may be revived, and that the cause she has espoused may be advanced. There is a hasty marriage; but the ceremony is barely concluded before the bridegroom is deserted, and his wife has gone no man knows whither. Tanger is left lamenting, and in his temporary impecuniosity accepts a commission to attempt the detachment of one Groschaud, a French general of Siamese celebrity, from the Republic, and to urge his adhesion to the Royalist cause. This takes him to Brivac, where many and varied adventures await him. Here he meets and falls in love with Bluette, a *café chanteuse*, whom he rescues from fire in the crowded cathedral of a neighbouring pilgrimage town. Here, too, he fights a duel (not, by the way, of the French journalistic type), and goes in fear of arrest. The remainder of the book is concerned with the identification of Bluette with Tanger's fugitive wife, and the happy consummation of a union that began in mystery and almost ended in tragedy.

If we say that *Alain Tanger's Wife* pleases us less than *The Romany Stone*, let the blame be ascribed to our personal idiosyncrasy, which delights in the bluff, breezy doings of the Derbyshire tale rather than in the sensuous, almost hysterical atmosphere of modern French life here portrayed. Mr. Yoxall has prejudiced himself, too, in our humble opinion, by persistently writing his conversations in a literal translation of French idiom. A little of this is undoubtedly effective, and adds vivid local colouring; but a book full of it is wearisome, if not cryptic, and the jargon tends to grow grotesque.

Despite these blemishes, however, the book is a notable one in many ways, head and shoulders above the ruck that stocks the shelves of the circulating library. It contains much fine, conscientious work, and marks another and a very distinct step in Mr. Yoxall's upward development as a novelist of force and calibre.

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The Arithmetic of Commerce and Trade. By S. Jackson, M.A. This is an exceedingly useful and comprehensive treatise on practical methods of teaching arithmetic. Every chapter of the book is well developed, and some splendid exercises are appended. It would be a distinct improvement to the book if answers were included, as without these it is of no use to the home-worker attached to the evening continuation school. The chapter on "British and Metric Tables," covering some twenty odd pages, is invaluable.

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* *Alain Tanger's Wife.* By J. H. Yoxall, M.P. (London: Hutchinson.)

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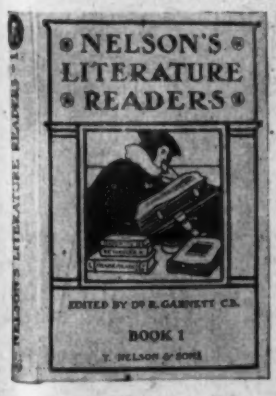

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